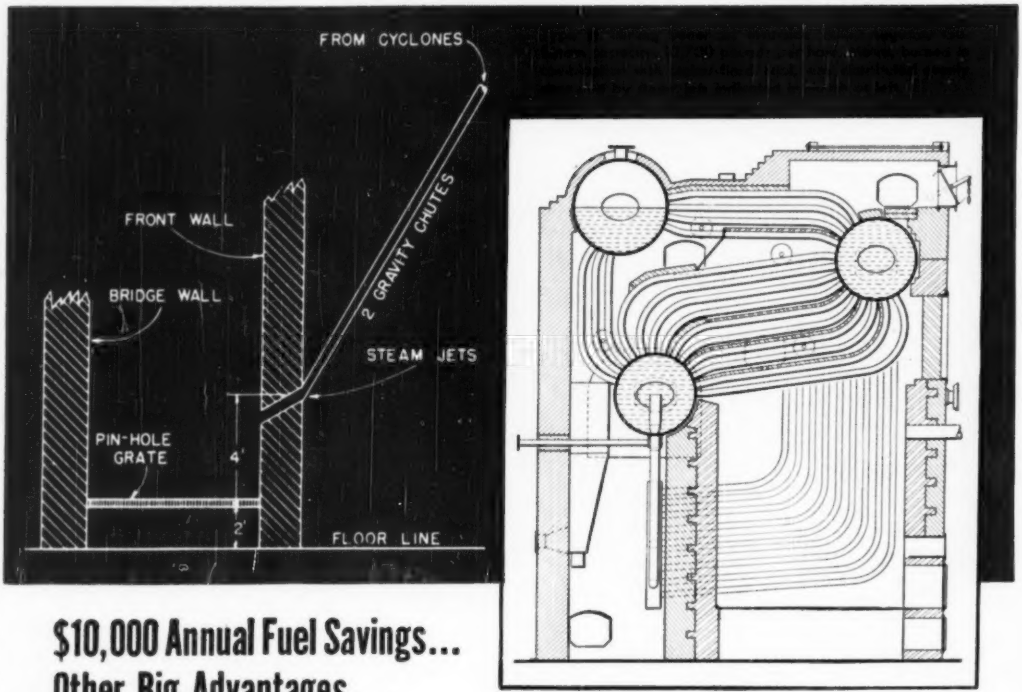
· DECEMBER 1950 ·

Departments

Riverside Mills turns WASTE into PROFITS



$10,000 Annual Fuel Savings... Other Big Advantages... with NEW B&W BOILER

Burning refuse in a boiler—even primarily for disposal—isn't always easy. That's why there's big news in the modernized boiler plant operation at Riverside Mills, Augusta, Georgia—where an unusual kind of waste is being burned . . . *efficiently* . . . in a new Type H Stirling Boiler.

Problem: disposal of "motes" . . . refuse from the willowing, or cleaning, of cotton waste, consisting of leaves, dirt, and stalks, separated by screening from various by-products of cotton and wool manufacturing.

Plan: to dispose of the motes entirely by burning, and to utilize their heat content (about 1/8 that of coal, volume for volume) to generate steam.

Results: three to four tons of coal saved daily; complete disposal of motes; quick, trouble-free response to rapid boiler load swings; improved production.

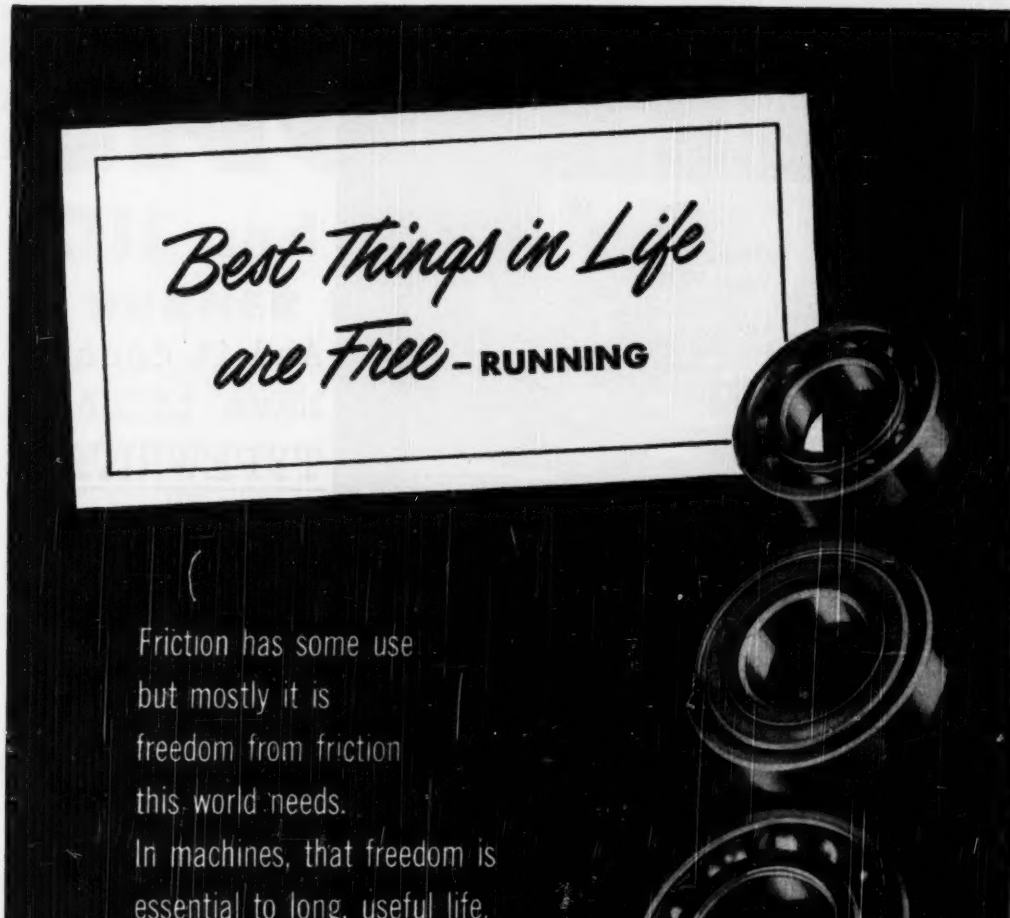
Helping turn boiler plant problems into profits is an 80-year-old story with B&W. Perhaps its creative approach to boiler engineering is just what is needed for a profitable solution of *your* steam-generating problems.

The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

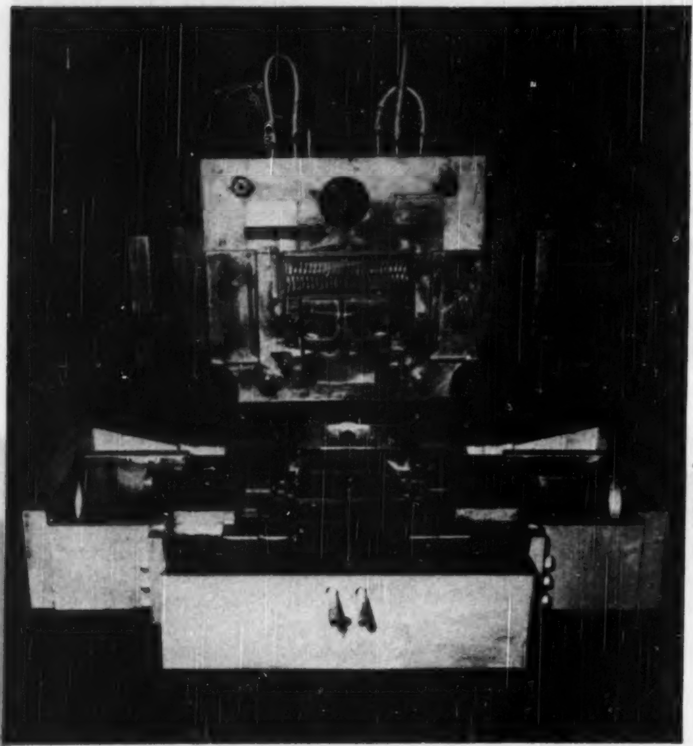
Helping Industry Cut Steam Costs Since 1867

G-493



MECHANICAL ENGINEERING, December, 1950, Vol. 72, No. 12. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50¢; to nonmembers one year $7.00, single copy 75¢. Postage to Canada, 75¢ additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

 For Editorial Contents See Page 953



And it doesn't have to be **TYPEWRITERS** you're die casting!

Accuracy calls for POTOMAC M

HOT-WORK DIE STEEL

"HOT-WORK STEELS"

is the title of a new, six-page folder that tells about the chromium, molybdenum, vanadium Hot Die Steel known as POTOMAC M—and also covers other grades for other hot-work operations. Secure your copy—*write today!*

ADDRESS DEPT. ME-12

In the precision casting of aluminum, POTOMAC M Hot-Work Die Steel is especially favored as the material for die-casting dies because its properties help assure accuracy of the steel itself *after* heat treatment. Die makers have found that size changes are held to a minimum.

Dimensional stability is thus the *first* contribution that POTOMAC M makes to accuracy.

Production accuracy of the die after it is in service is maintained also by the resistance of POTOMAC M to wear, to heat checking, and to metal wash.

Allegheny Ludlum makes a complete line of steels for hot-work tooling of various kinds—so, whether your need is the mass producing of duplicate parts or fabricating a few of them, call up "A-L" every time for hot-work counsel or service or both. Tell us your requirements.

ALLEGHENY LUDLUM
STEEL CORPORATION
Pittsburgh, Pa.

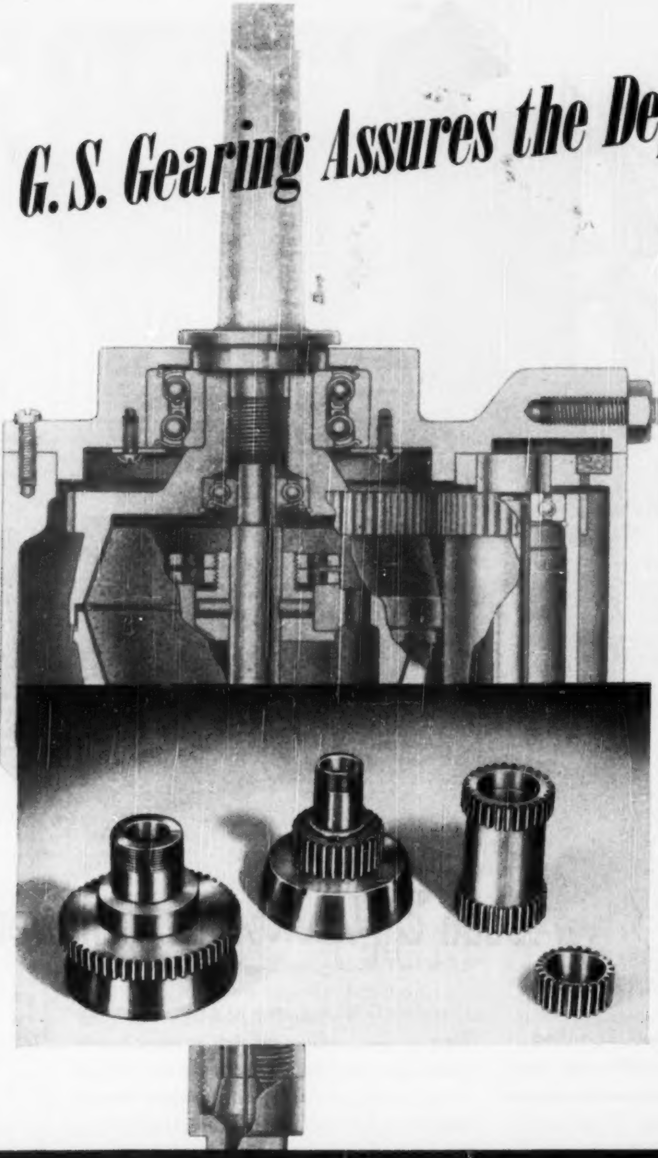
TOOL STEEL DIVISION: DUNKIRK, N. Y.

Fine Tool Steels Since 1854

A-L

G.S. Gearing Assures the Dependability of Snow

TAPPING, DRILLING AND THREADING EQUIPMENT



SNOW MANUFACTURING COMPANY has long enjoyed an enviable reputation for leadership in the field of Automatic Drilling, Tapping and Threading Machines. The absolute *dependability* and long life of their equipment is largely due to the consistent use of finest materials and the extreme precision with which all parts are made.

Invariably Snow specifies G.S. Fractional Horsepower Gearing for their driving mechanisms. They, like so many other leading manufacturers from coast-to-coast, have found that G.S. Gearing assures a degree of *uniform* high quality and trouble-free operation which *only these better Gears can give!*

If you have a Fractional Horsepower Gearing problem, however simple or intricate it may be, submit it to our capable staff. Get the advantage of our unusual "know-how" gained thru more than 30 years' *intensive specialization* in the design and quantity production of Gearing ranging from 12 to 96 D.P. and finer. Ideas, suggestions and moderate cost estimates won't cost you one penny. Will you write for them today?

Send for Free..

new 6-page folder which illustrates and describes G.S. facilities, Small Gearing and applications together with handy charts for those who specify Gearing from 12 to 96 D.P. and finer. Will you ask for it on company stationery, please?

FRACTIONAL HORSEPOWER GEARING

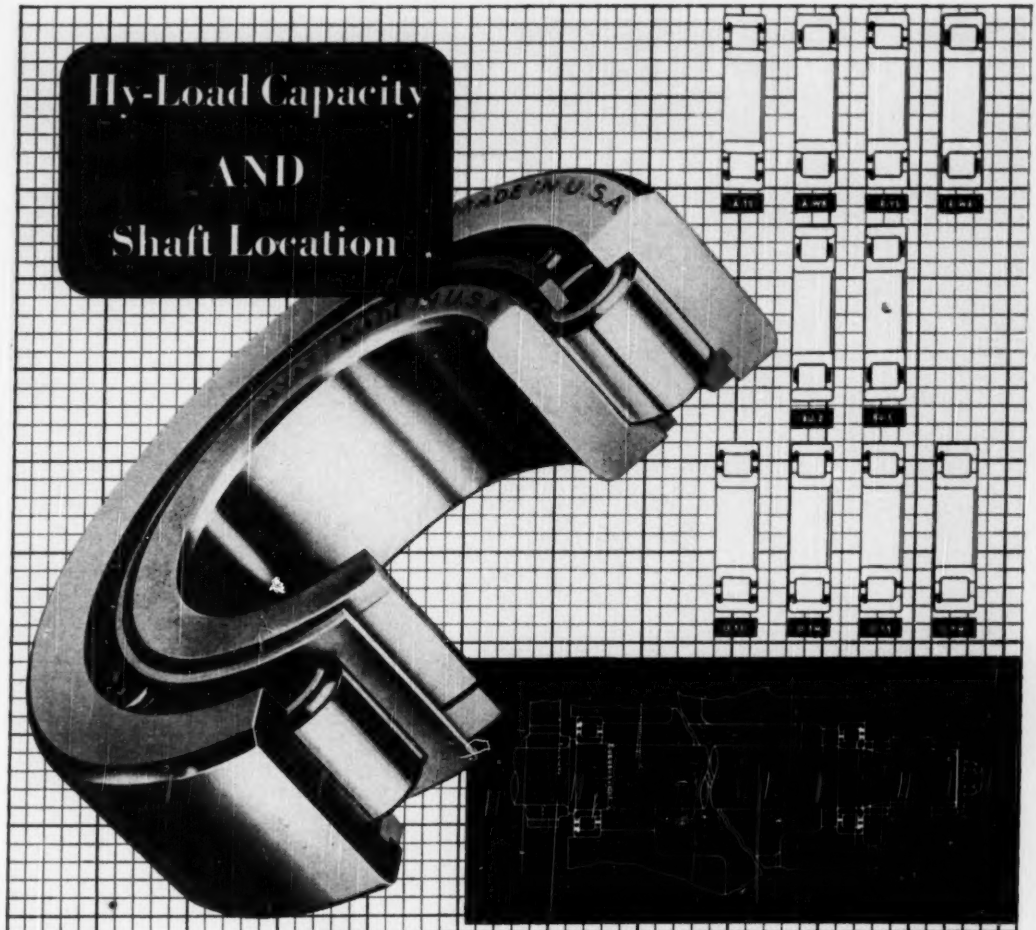
GEAR Specialties, Inc.

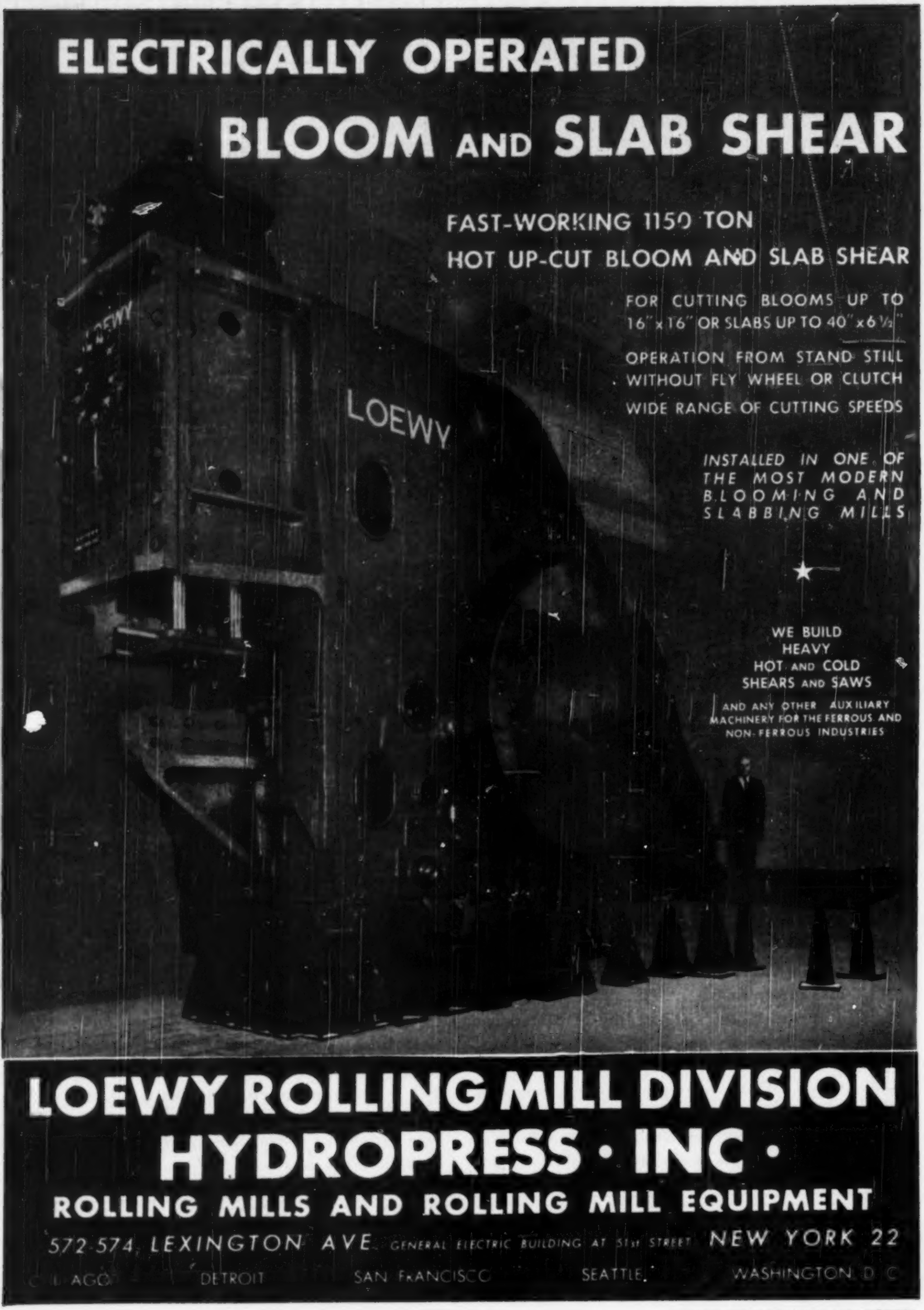
Spurs • Spirals • Helicals • Bevels • Internals • Worm Gearing • Racks • Thread Grinding

2635 WEST MEDILL AVENUE • CHICAGO 47, ILLINOIS

MEMBER OF AGMA

WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF FRACTIONAL HORSEPOWER GEARS


Hy-Load Capacity
AND
Shaft Location
MADE IN U.S.A


ELECTRICALLY OPERATED
BLOOM AND SLAB SHEAR
FAST-WORKING 1150 TON
HOT UP-CUT BLOOM AND SLAB SHEAR
FOR CUTTING BLOOMS UP TO 16" x 16" OR SLABS UP TO 40" x 6½"
OPERATION FROM STAND STILL WITHOUT FLY WHEEL OR CLUTCH
WIDE RANGE OF CUTTING SPEEDS
INSTALLED IN ONE OF THE MOST MODERN BLOOMING AND SLABBING MILLS
WE BUILD HEAVY HOT AND COLD SHEARS AND SAWS
AND ANY OTHER AUXILIARY MACHINERY FOR THE FERROUS AND NON-FERROUS INDUSTRIES
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DETROIT
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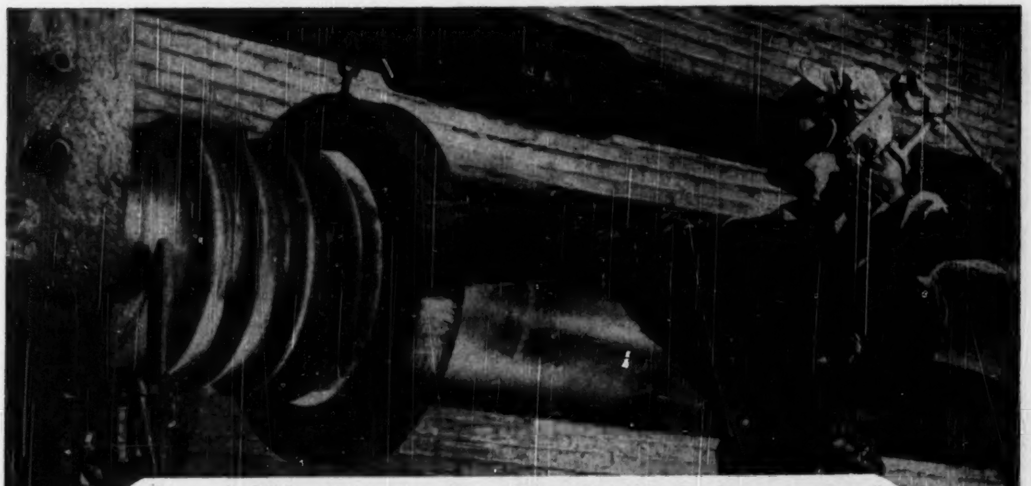


Special Machine makes first 30" O.D. Corrugated Alloy Piping . . .

The first 30-inch O.D. chrome-moly corrugated piping was recently formed on the unique device shown here. Totaling some 90 feet over-all, eight pieces comprise the complete order. They are for the major part of the exhaust-steam line from a topping turbine in a main power station of a metropolitan utility in the East.

Beyond physical size itself, the major problem in fabrication was to preclude cracking, a defect much more apt to occur in forming chrome-moly than in working either carbon or carbon-moly steels. Through carefully controlled incremental heating and subsequent compression on a specially built machine, the corrugations were formed, giving the final corrugated piping five times the flexibility of plain piping.

Specific know-how in incremental heating was to a large degree responsible for the success of this operation . . . this and an extensive background in the fabrication of alloys. Over the years special alloy fabricating methods have been developed by Kellogg engineers, who have been entrusted with such recent innovations in power piping at the first HT-HP stainless steel installation and the fabrication of piping for the original 1050°F. station.

Knowledge of such special techniques is among the advantages utility companies gain when they specify M. W. Kellogg HT-HP power piping.

Special studies of unusual problems such as graphitization to assure long life and low maintenance.

Metallurgical research by recognized specialists who have made major contributions in this field.

M KELLOGG W

M. W. KELLOGG

Exclusive Equipment for accurately analyzing stresses in piping and providing unique data for critical installations.

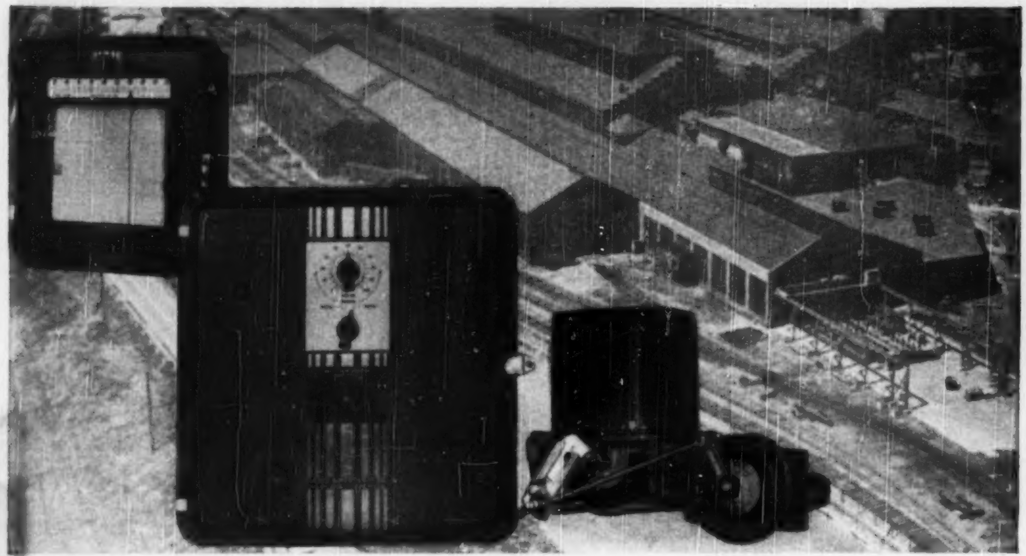
Complete facilities for the fabrication of steel products from simple forgings to specially cast bi-metallic devices.

Top welding performance in shops and in the field by welders accustomed to working under X-Ray checks.

Quality control, devised by metallurgical experts, embracing forming, heat treating and non-destructive testing.

Vessels
Exchangers
Condensers
Process Piping
Forged and Welded Fittings
Radial Brick Chimneys

The M. W. Kellogg Company (Subsidiary of Pullman, Incorporated)—Offices in New York, Jersey City, Buffalo, Los Angeles, Tulsa, Houston, Toronto, London and Paris



Major Advance in Electric Control Increases Production From Industrial Operations

With production demands reaching toward fresh all-time highs, this new P.A.T.'50 Control comes at the ideal time to help thousands of firms increase the output of their industrial furnaces. Here's why:

This Control has something that's brand new. It acts on the *speed* of swings in furnace load, as well as on their size and permanence. Thus, if temperature changes gently, it is gently nudged back into line. But if it starts off briskly—as when the furnace door is opened—P.A.T.'50 reacts briskly. The faster the change, the further P.A.T.'50 moves the fuel valve. Then, at the instant this action begins to head off the change, the Control starts backing away. By putting on the brakes it brings temperature back in line smoothly, rapidly.

This "Rate Action" increases production because it reduces the length of time a furnace is off temperature. It means more heats per week.

P.A.T.'50 is the Only electric positioning control with Rate Action. It's a unique L&N contribution to automatic regulation.

Also, Proportioning and Reset Actions are more responsive than before. These two components have always been vital to automatic control, and of course continue so. They stop the normal, every-day temperature swings which are started by changes in the size and permanence of the furnace load.

When we gave P.A.T. its third component of rate action—and introduced it in this '50 model—we were able also to increase the sensitivity and range of adjustment of proportioning and reset components. The resulting improvement in control action shows up at all times, but especially when temperature is being stubborn—trying to edge away from the control point, or to level off incorrectly. Even without rate action, P.A.T.'50 would do a better-than-ever job. But with rate action, results are far superior to any previous electric control.

The News is in the Control Unit. Everything new in P.A.T.'50 is in the Control Unit—the device in center of above illustration which is usually mounted below the Speedomax or Micromax Recording Controller, and which links that instrument to the fuel-valve-driving mechanism. In line with our policy of making improvements readily available to users of our equipment, earlier installations of P.A.T. Control can be converted to P.A.T.'50 by replacing the Unit and making slight changes in the Controller. The new Unit is fully electronic—has no moving parts except two hermetically-sealed relays.

For complete details, contact our nearest office, or write us at 4963 Stenton Ave., Philadelphia 44, Pa.

LN

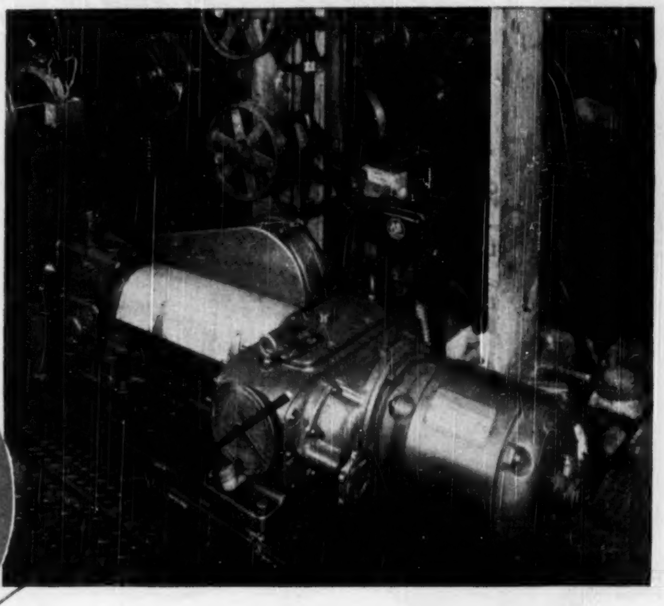
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

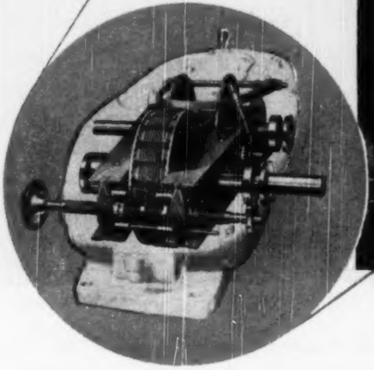
LEEDS & NORTHRUP CO.

Jrl. Ad ND4-33(1)

Accurate Wire Drawing Assured
WITH LINK-BELT P.I.V. DRIVE

Operations of this 9-Die Tandem Copper Wire Drawing Machine are perfectly timed by the motorized P.I.V. Drive. The shaft rolls operate at precise speeds in drawing 5/16" to ¼" copper rods down to #16 B. & S. Gauge Wire.





Roll shafts on this wire drawing machine must run at exact speeds to assure uniform wire sizes. The precise speed for a given wire size is instantly obtained, in a stepless operation, through the Link-Belt P.I.V. Drive. When adjusted, the speed remains constant indefinitely, without slip or creep.

The P.I.V. Drive eliminates stops for gear changes because speeds are changed by a hand wheel while the machine is running. Speeds are varied the smallest degree for the most delicate work. Product quality is improved . . . waste and damage are avoided . . . valuable time is saved.

Wholly enclosed and running in oil, the all-metal P.I.V. Drive operates efficiently with a minimum of attention.

Find out how the P.I.V. Drive can benefit your business. Send for Book 2274. It has information on eight styles of the P.I.V. Drive, from ½ to 25 h.p., to suit a wide range of applications.

POSITIVE

Power is transmitted from one pair of grooved wheels to another, through a unique chain which forms its own teeth, without slip.

INFINITELY VARIABLE

Speed ratio changes are stepless. Adjustment by easily operated hand wheel permits the most minute variation between input and output speeds, within range of the drive.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Johannesburg. Offices, Factory Branch Stores and Distributors in Principal Cities.

12,088

Wherever exact synchronization of rotating parts must be maintained in continuous duty operation . . . INDUSTRY USES

LINK-BELT

P.I.V. *Variable Speed Drive*

WHY SO MANY  LURES?

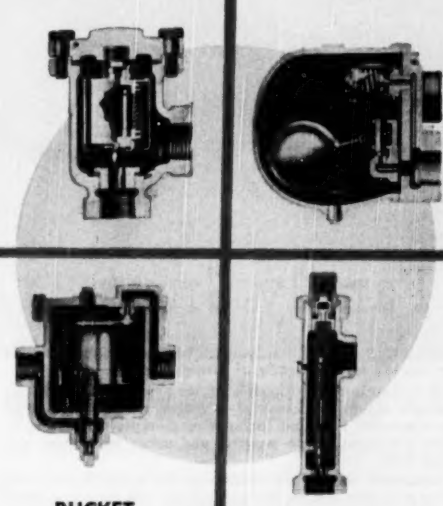
A practical idea for users of STEAM TRAPS

Many readers of this publication can remember when there was only one kind of steam trap and when one trap to a room or a building was enough. As long as the trap "tilted," everybody was happy.

The science of steam trapping has come a long way since then but we still have with us the engineer who tries to "standardize" on one type of trap for the whole plant and the steam man who doesn't realize that the cost of Sarco traps is so reasonable today that it pays to put one on each coil.

One thing is certain. You will need several types of steam traps to lure the utmost out of your fuel and your production equipment. Sarco makes five distinct types of steam traps and is in a position to recommend the right type for each job.

And you can't tell by the cost. An inexpensive type of trap may be the best and the most expensive trap the worst type you could use on any particular job. You can get the right trap the first time for each job by asking the Sarco Specialist near you or writing for our Selection Chart No. 1600.



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SARCO
SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
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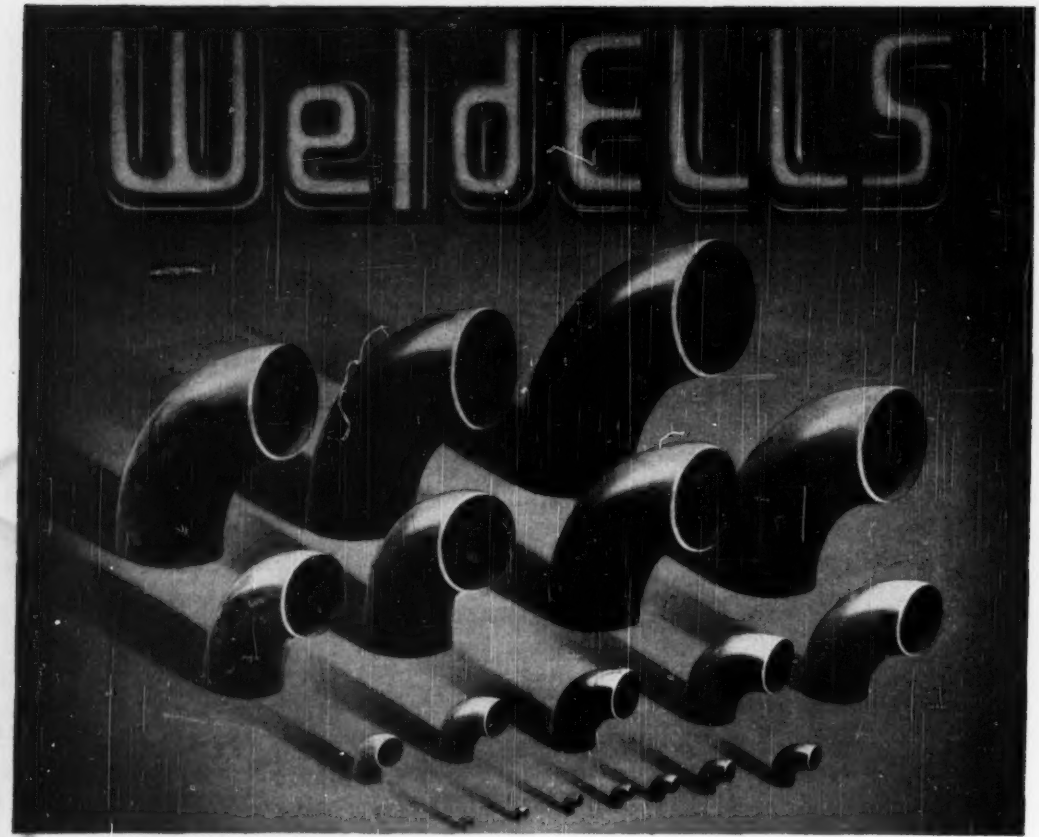
IMPROVES PRODUCT QUALITY AND OUTPUT



Family Group *. . . proud of its size . . . and traditions*

Large group though it is, you see here only one branch of the world's largest family of fittings for pipe welding.

It is simply the stock sizes of long-radius WeldELLS in a single weight and material — merely a small fraction of the enormous line that includes more types of fittings, in more materials, more weights and more sizes than any other line.

Important though the breadth of the WeldELL line is to every man who designs or erects piping, still more important is the significant fact that the WeldELL family grew to this size because nothing less could meet the demand for fittings of WeldELL quality and uniformity to satisfy every conceivable piping condition.

Yes, there is a Taylor Forge Fitting for every purpose. From the smallest to the largest, every fitting in the WeldELL line shares the principle of sound engineering design and job-speeding utility that Taylor Forge has consistently applied for half a century.

Mail the coupon for Taylor Forge catalog.

TAYLOR FORGE

TAYLOR SPIRAL PIPE is available in a broad range of sizes and thicknesses. Coupon brings Spiral Pipe Bulletin 493.

TF

TAYLOR FORGE & PIPE WORKS

P. O. Box 485, Chicago 90, Illinois

Offices in all principal cities: *Eastern Plant:* Carnegie, Pa. *Western Plant:* Fontana, Calif.

☐ Please send Catalog 484 covering welding fittings and forged steel flanges.
☐ Send Bulletin 493 covering Taylor Spiral Pipe and related fittings.

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POSITION____________________

COMPANY____________________

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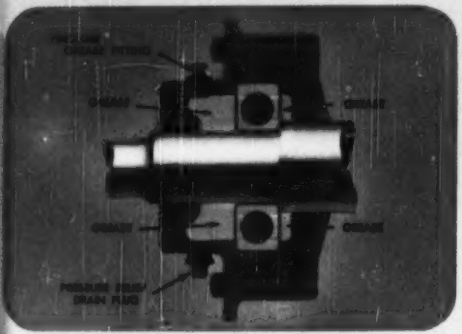
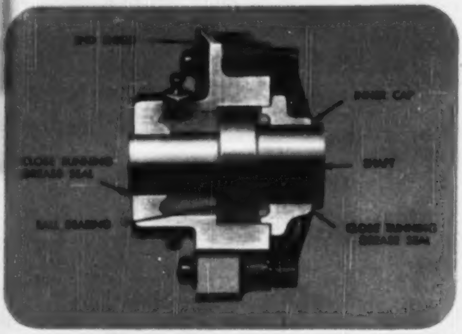
Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.
504-1250


TRI CLAD MOTORS
will run safely without relubrication for as long as any general-purpose motor you can buy—
and if the application makes relubrication a *must*, you can grease a TRI CLAD *without* halting production
GENERAL ELECTRIC
HERE'S WHY

❶ **EXTRA BEARING PROTECTION** — Tri-Clad gives you extra bearing protection because heaviest standard-service bearings are carefully selected to withstand severe loads for long periods.



❷ **EXTRA GREASE** — Four times the ordinary amount of grease is packed into the large Tri-Clad grease reservoir. Since bearing life depends on grease, this means that Tri-Clad motors will run safely for years — for as long as any general-purpose motor you can buy.



❸ **SEALED-IN BEARINGS** — Bearings and grease are completely sealed in a cast housing with *long running seals* for extra protection from dirt, dust, and lubricant leakage.

TRI/CLAD MOTORS will run safely without relubrication for as long as any general-purpose motor you can buy—

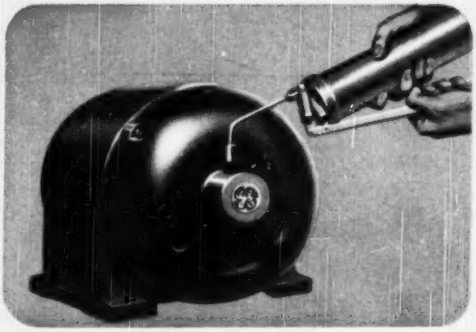
Tri-Clad extra lubrication "protection" can save you money because:

1. Tri-Clad's oversize grease reservoir and the heaviest standard-service bearings mean you do not have to bother with greasing between motor check-ups.

2. When relubrication is needed on those tough applications, you can grease a Tri-Clad without interrupting production-line operations.

Tri-Clads are grease-gun easy to lubricate *on the job*. Moreover, a Tri-Clad motor will run safely where an ordinary motor would fail. Chances are you'll be spared the cost of a "special" motor.

YOU BE THE JUDGE! The best way to prove to yourself that Tri-Clad gives you the most for your motor dollar is to contact your local G-E office. Tri-Clad stocks are complete. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



❹ **PRESSURE-RELIEF GREASING** — An efficient system of pressure-relief lubrication (with standard fittings) enables a Tri-Clad motor to be quickly and easily greased on the job when and if it's needed.

GENERAL ELECTRIC

DOWELL SERVICE

CHEMISTRY APPLIED TO MAINTENANCE CLEANING PROBLEMS

Dowell Service provided a fast, effective solution!

A midwestern power and light company, operating 350,000 lb. per hour steam generators, was having numerous unscheduled shutdowns because of tube failures. Although tubes were turbined periodically and inspections showed that deposits were small in amount, tubes continued to blister. A crisis was reached when 11 outages occurred in 18 days!

Dowell Service provided the answer with a *more effective, faster and more economical* method of maintenance cleaning. Tube failures at this power house have been practically eliminated. A regular cleaning schedule using Dowell Service has solved similar problems in many other plants.

What is Dowell Service? Experienced engineers fill the equipment to be cleaned with special liquid solvents designed to dissolve and disintegrate the profit-stealing deposits from all surfaces, even the most complex, *in a few hours.* The solvents are carried to the job in Dowell pump trucks and are pumped into the unit through regular connections. There is no dismantling.

Call Dowell for consultation on your cleaning problems. A Dowell engineer is as near as your telephone. No obligation, of course.

Other recent Dowell jobs:

Anthracite filters cleaned by Dowell Service in one working day. Backwash rate increased from 75 to 385 g.p.m.

★

Five air conditioning compressors cleaned for office building in 8 hours by Dowell Service. Result: $15.70 per day saved on power demand.

★

Two 40,000 lb./hr. boilers cleaned for paper company in 24 hours. Result: 37 tons of fuel per day saved under same load conditions.

CALL

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

New York 20	Buffalo 2	Kansas City 8	Mt. Pleasant, Mich.
Boston 16	Cleveland 13	Wichita 2	Hamilton, Ohio
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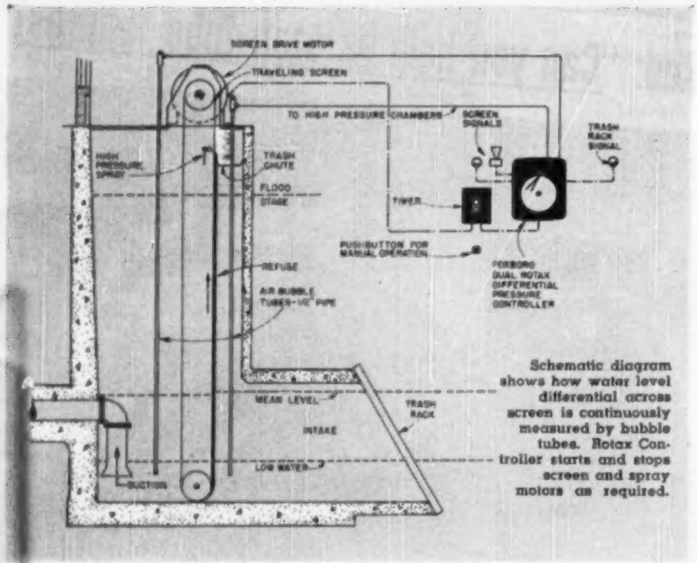
Baltimore 18	Detroit 2	Houston 2	Salem, Illinois
Wilmington 99	Chicago 2	New Orleans 12	Borger, Texas
Richmond 19	St. Louis 8	Ft. Worth 2	Midland, Texas
Jacksonville	Indianapolis	Shreveport 69	Wichita Falls, Texas
Atlanta	Louisville	Anniston, Alabama	Lafayette, La.

Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

Make traveling intake screens positively "Plug-Proof"



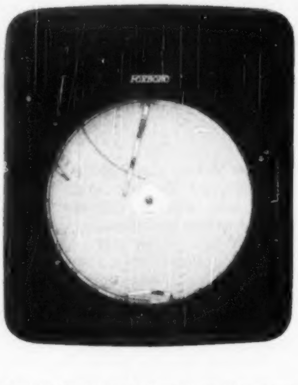
Schematic diagram shows how water level differential across screen is continuously measured by bubble tubes. Rotax Controller starts and stops screen and spray motors as required.

. . . with Foxboro liquid level type screen control

Make sure your intake suction well can't go dry when excessive refuse suddenly piles up on the traveling intake screen!

The Foxboro Traveling Screen Control System automatically starts the screen-rotating motor and the cleansing spray whenever refuse accumulation causes the water level difference between opposite sides of the screen to exceed a certain preset value. Quickly, it purges the screen of refuse and restores the intake level to normal — or sounds an alarm indicating that the cleaning mechanism is unable to cope with the difficulty. What's more, this action takes place only when the screen actually becomes clogged . . . no waste of power or unnecessary wear on mechanism through needless periodic operation.

The Foxboro Traveling Screen Control System is easy to install, inexpensive to operate, and pays big dividends in better intake operation, less maintenance and greater peace of mind. Write for complete information. **The Foxboro Company, 182 Neponset Ave., Foxboro, Mass., U.S.A.**



ROTAX Liquid Level Controller. The heart of the system, translates level differential into operation of motors. In addition, it can operate warning horn or light in case of unusually severe fouling. Circular or rectangular case models.

FOXBORO
REG. U. S. PAT. OFF.

INSTRUMENTATION
INDICATING · RECORDING · CONTROLLING

ERIE CITY 3-Drum Boiler Exceeds Predicted Efficiency of 84.56% at Mueller Brass Co.

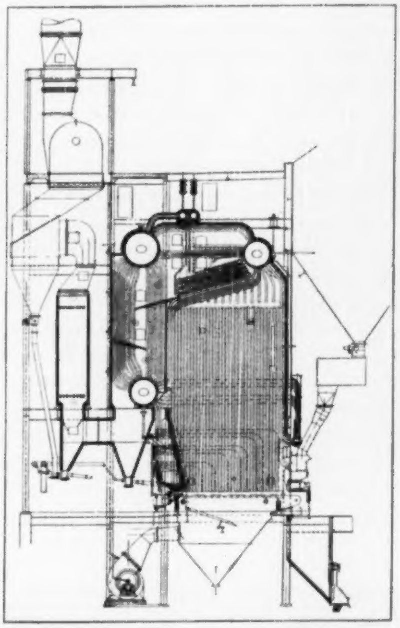
BOILER NO. 6 at Mueller Brass Co., Port Huron, Mich., an Erie City 890 h.p. 3-drum boiler, outdoor installation, designed for 675 psi, was recently given a 21 hour test under normal operating conditions.

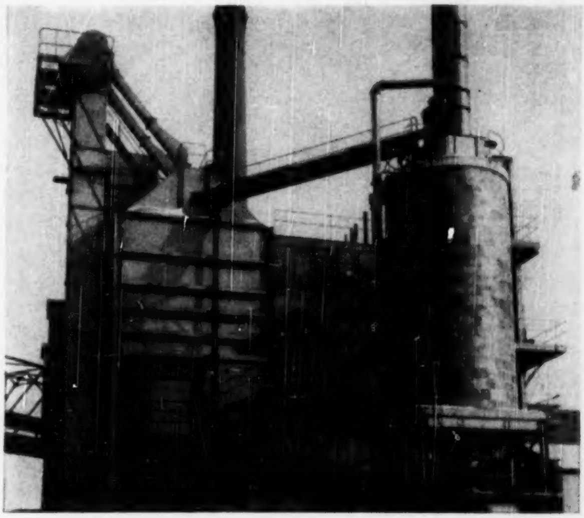
During this test the records show that 121,311 pounds of coal produced 1,156,400 pounds of steam, an evaporation rate of 9.53 pounds of steam per pound of coal, an efficiency of 88.5%. A computed heat balance based on CO_2, flue gas and other test readings, indicate an efficiency of 85.15%. Either figure shows that the prediction was surpassed by a comfortable margin.

The Erie City Steam Generator, complete with water walls, economizer and superheater, is stoker fired with Ohio Strip Mine Coal of 11,513 B.T.U.

Boiler and Water Walls	11,600 sq. ft. Heating Surface
Economizer	7,344 sq. ft. Heating Surface
Superheater	500° F.
Furnace Volume	5,500 Cu. ft.
Stoker	190.7 sq. ft. (effective)

For a detailed report on the complete test performance, write for bulletin SB-40.





Erie City 890 hp. 3-Drum Outdoor Type Steam Generator at MUELLER BRASS CO., Port Huron Mich.

COMPLETE STEAM POWER PLANT EQUIPMENT

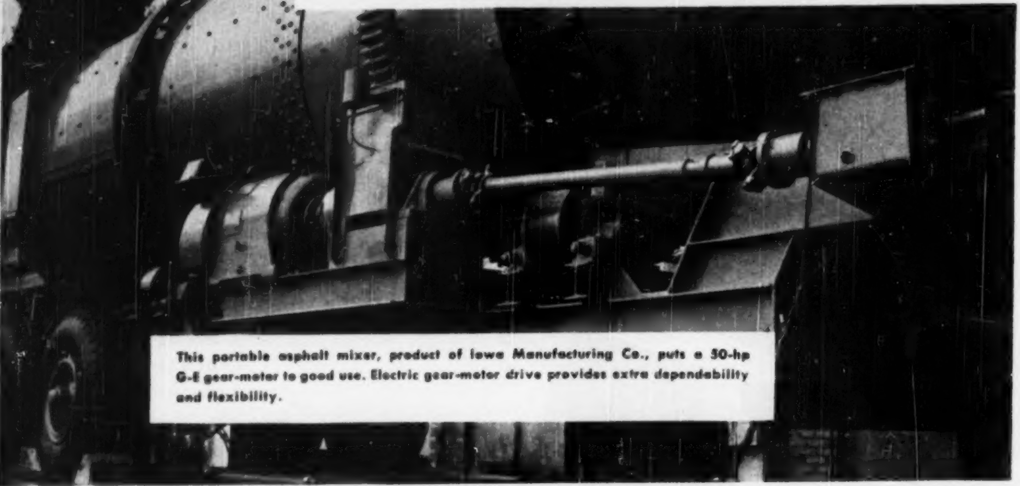
ERIE CITY

Complete Steam Generators • Type C 3-Drum Boilers • Types VL & VC 2-Drum Boilers • "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • "Keystone" Packaged Steam Generators • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

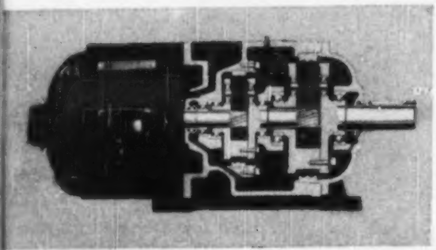
ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*

Yes! we said gear motors UP TO 150 HP

for dependable low-speed drive



This portable asphalt mixer, product of Iowa Manufacturing Co., puts a 50-hp G-E gear-motor to good use. Electric gear-motor drive provides extra dependability and flexibility.



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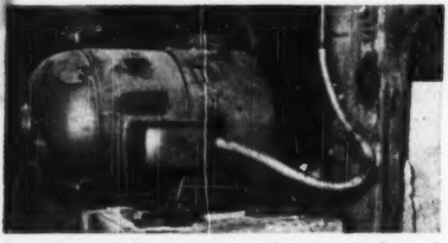

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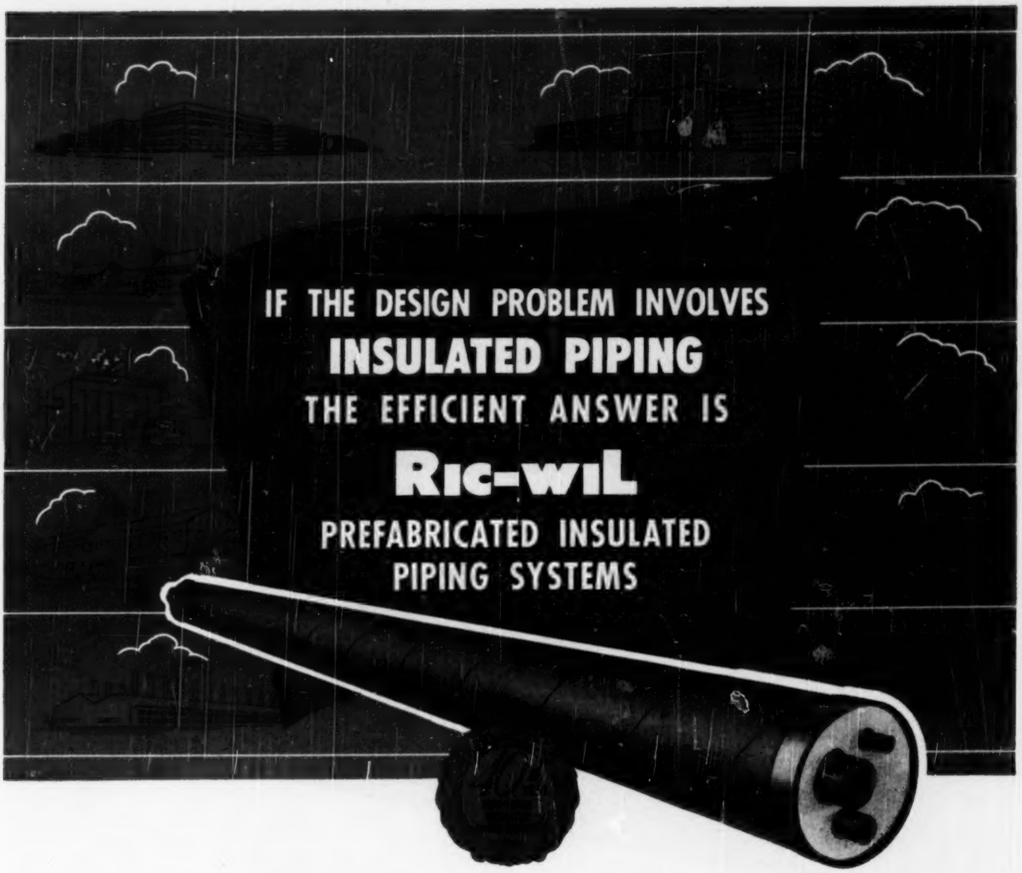

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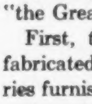

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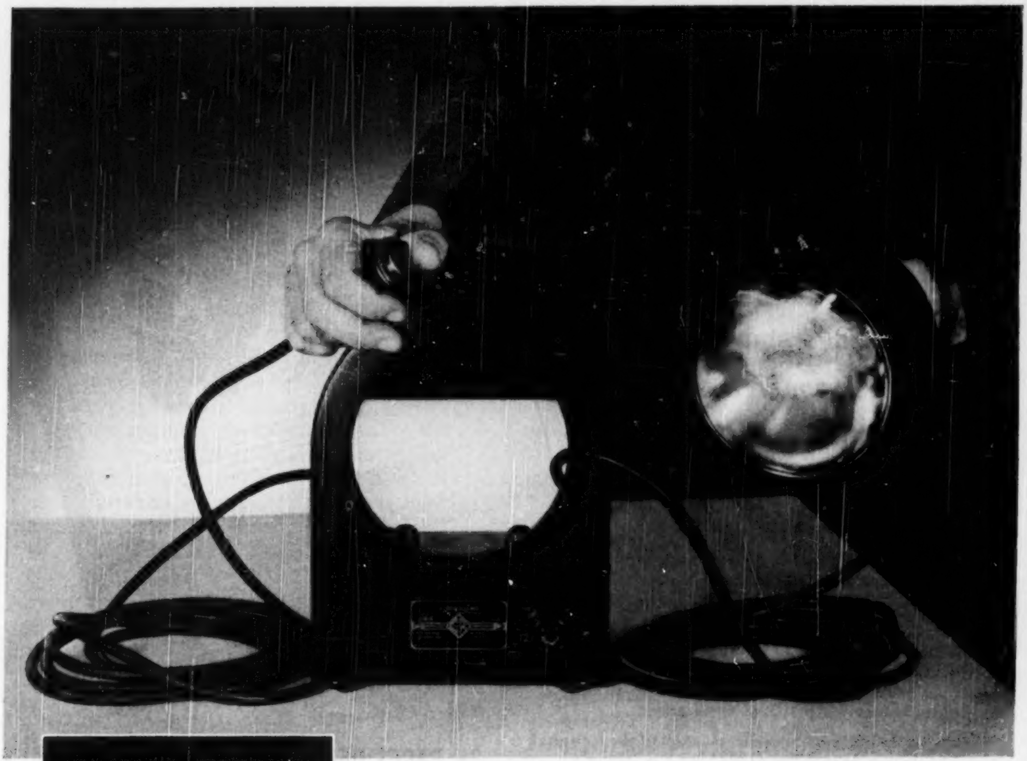

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MECHANICAL ENGINEERING

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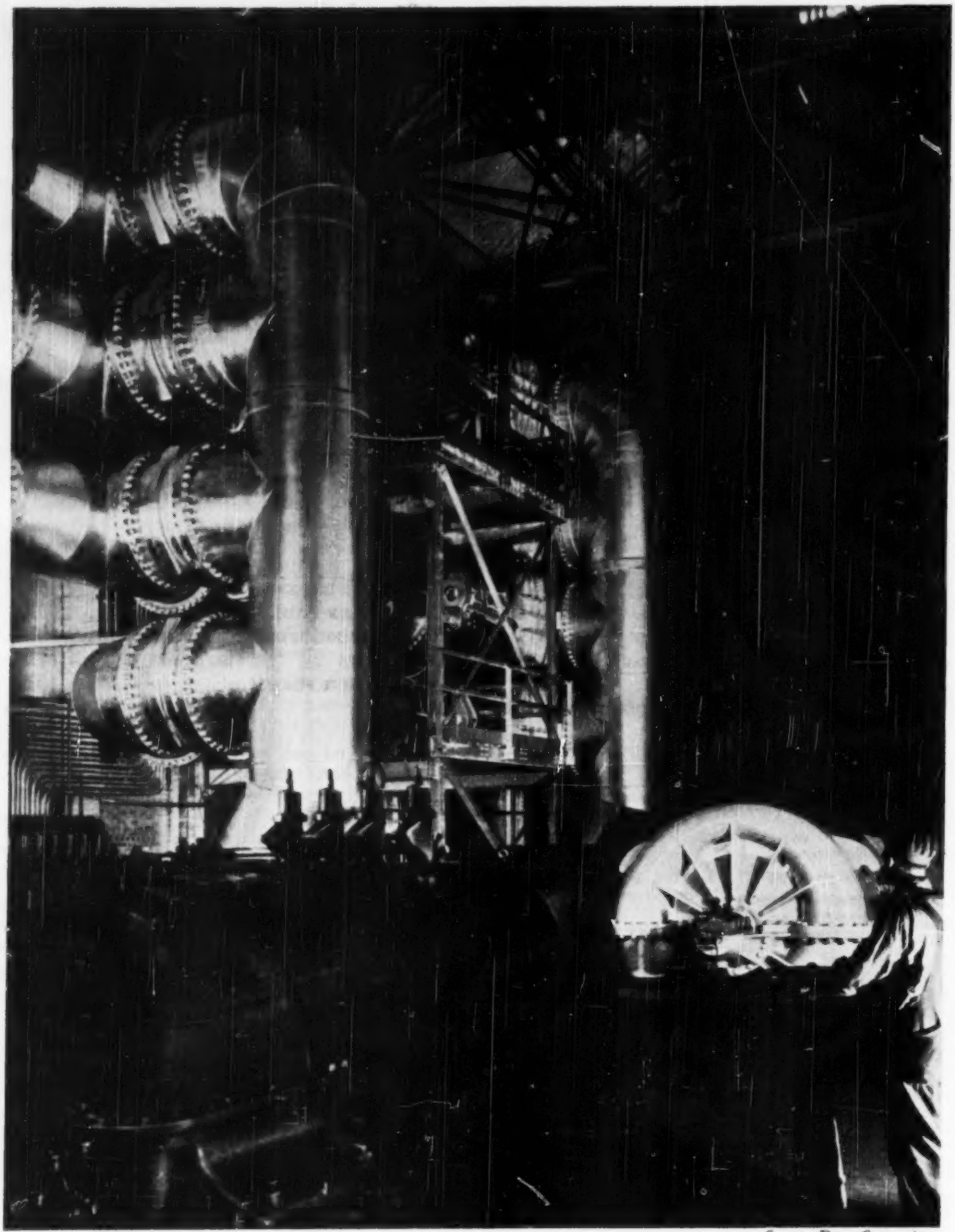

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Volume 72
No. 12

MECHANICAL ENGINEERING

December
1950

GEORGE A. STETSON, *Editor*

ECPD at Cleveland

IN his annual report as chairman of the Engineers' Council for Professional Development, Dr. Harry S. Rogers discussed frankly and constructively the problems and plans of that organization. He characterized ECPD as an intersociety, intraprofessional body as compared with Engineers' Joint Council which is intersociety, extraprofessional. He urged "that we (ECPD) define our undertakings more clearly and specifically; that the programs of our committees have sharper focus and continuity; and that we organize internally and co-operatively to produce more tangible and constructive achievements." He summarized the tasks which confront the principal ECPD committees and concluded with a direct challenge to engineers and the engineering societies by asking: "Do you want this kind of an ECPD? Are you willing to provide for it financially—with money, and to supply it with strong representation—with men?" The complete text of Dr. Rogers' report appeared in our November issue under the title, "What Program for ECPD?"

There is nothing in Dr. Rogers' summary of the tasks ahead of ECPD that was not implied in the statement defining the four principal areas of ECPD's work that was quoted in an editorial in this magazine for August, 1932, and in the explanatory article on ECPD by C. F. Hirshfeld, first published in our September, 1932, issue. These four areas of ECPD's work cover the four phases of the professional development of the individual engineer—precollege guidance, undergraduate education, the first years of engineering practice, and the ultimate recognition of professional competence. But as Dr. Rogers pointed out, particularly in his comments to ECPD at Cleveland in October, the achievements of the Council after eighteen years are not impressive when compared with the high hopes of 1932 and the potentialities of the program set up at that time.

ECPD is pioneering in a difficult field. Even when the purpose and scope of its task have been clearly defined and the elements of its program are described in specific detail, implementation of that program still involves the wholehearted co-operative support of many organizations and individuals. Professional development of individuals is a slow process. Progress is difficult to measure. The influences which bear upon it are obscure and sometimes remote and indirect. One can point to aptitude-testing techniques in use, to guidance pamphlets published, to lists of curricula accredited, to training manuals, to reading lists and self-appraisal forms, to widely adopted canons of ethics, to uniform grades of membership and minimum standards of membership requirements, and still be unable to assert positively to what extent any or all of them have been helpful in making better engineers or a better engineering profession. This will always be so, no matter how deeply ECPD and its work enter into the consciousness of future generations of young men or how many members of the profession, or how many educational institutions, engineering societies, and employers of engineers, co-operate with it. But failure to measure results in quantitative terms does not weaken the conviction that the objectives ECPD was organized to attain are unquestionably worth while. These objectives demand bold imaginative planning and vigorous and practical implementation.

Dr. Rogers frequently reminded the Council at Cleveland that ECPD's objectives had been set for it by the constituent societies in the charter granted by them under which it operates. The Council, he pointed out, had established committees to plan and administer projects to meet these objectives. It was therefore the responsibility of the Council to be familiar with the committees' activities and to supervise their work closely. With pressing needs and abundant opportunities for service, time should be devoted to projects of high importance and should not be wasted on those which could be carried on by other agencies or were inconsequential. In the exercise of this responsibility of the Council the Executive Committee, during the last year, he reported, had devoted a considerable portion of each meeting to a review of the work of one of the committees.

Under Dr. Rogers' skillful leadership the Council engaged in a considerable amount of self-analysis during the last year. As a result, a revised charter, approved at Cleveland, has been sent to the constituent societies for adoption. This revised charter introduces no new objectives but defines the original ones and methods of operation more clearly. Revised rules of procedure were also adopted at Cleveland. These are now written in more definitive language. They simplify the committee names, change two committees from special to standing committee status, and set up a new committee, as yet not organized, to deal with problems of engineering schools not related to the accrediting program. Thus has the Council taken a step toward defining its undertakings "more clearly and specifically" and giving its committees "sharper focus."

By far the most important project described at Cleveland, approval of which is already under consideration by the constituent societies with favorable action re-

ported by several, is that of the Training Committee. Throughout the past year the committee prepared a six-point comprehensive report entitled "The First Five Years of Professional Development." This voluminous report, on which action by the constituent societies is to be based, will constitute the substance of a proposed manual for the guidance of local groups of engineers in communities where there is a need and an opportunity to introduce postcollege training programs for young engineers. Active co-operation of local engineering societies, educational institutions, and employers will be essential for the success of projects initiated under this program. It is recognized by the committee that every community presents a special set of conditions, needs, and opportunities for putting a training project into effect. The committee's plan for implementation includes the hiring of a competent and well-qualified field secretary who will work with the committees which desire to introduce a training project. Once the work in a given community is well under way and operation of it has been assumed by the local engineering-society groups, local educational institutions, and local employers, the services of the field secretary will be needed no longer and he will be free to introduce a similar training project in another community. In approving the committee's plan the constituent societies also authorize ECPD to solicit funds for assuring the necessary financial support of the work of the field secretary. It was announced at Cleveland that more than half of the funds for the first year's operation are already pledged or in hand and the remainder appears to be readily forthcoming.

A thorough factual study of needs, opportunities, and methods of operation of the proposed project has been made by the Training Committee. The project itself is a revival of one of the earliest projects set up by ECPD under the guidance of Gen. R. I. Rees, first chairman of the committee, whose death resulted in postponement of it. Revival of the project was proposed by J. W. Parker during his ECPD chairmanship and A. C. Monteith was persuaded to accept chairmanship of the Training Committee which developed the present program. The project is broadly and boldly conceived and is typical of the type of worth-while projects awaiting the sponsorship of ECPD. It meets squarely the challenge for greater and more significant service by ECPD thrown out by Dr. Rogers, "that the programs of our committees have sharper focus and continuity; and that we organize internally and co-operatively to produce more tangible and constructive results." It is worthy of the enthusiasm for it that was so contagious at Cleveland.

In the first published statement about ECPD, which appeared in the September, 1932, issue of MECHANICAL ENGINEERING, C. F. Hirshfeld, ECPD's first chairman, wrote: "We would have the engineering profession studied more comprehensively than it has been. We would have a very careful selection of raw material and an equally careful preparation of that material for its work in the world. We recognize that education is in reality a lifelong process and that extension in years becomes more and more important as the field of activity is extended. Therefore, we would provide for such assistance and guidance as may prove possible and desirable after the completion of such formal studies as are generally becoming recognized as prerequisites for entry into the profession of engineering."

The six-point program of the ECPD Training Committee, presented at the Cleveland meeting, is a well-conceived means of fulfilling the objective stated in the concluding sentence of the foregoing quotation. It promises, at long last, to provide a practical program for the professional development of the young engineer. It is offered with full recognition of two cardinal principles which guided the committee: "that the final responsibility for professional advancement rests squarely upon the individual's shoulders, and that the engineering profession must provide the young engineer with both the opportunity for development and a favorable climate in which to grow. . . It offers a real opportunity for the employers, the colleges, and the societies to co-operate in making a definite contribution to the development of the young engineer and thereby to the profession and to society in general."

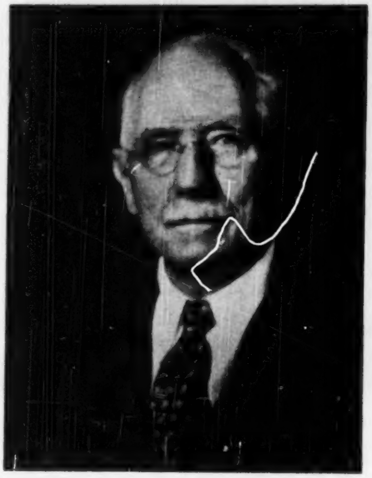
When the program of the Training Committee is put into effect—and there is no doubt that a sufficient number of the constituent societies will vote in favor of it—one large sector of ECPD's service to the profession will invade a number of engineering communities where individual engineers, local engineering groups, and employers of young engineers will have an opportunity never before offered of working directly under ECPD. Through its program of accrediting engineering curricula, ECPD is already well known in the field of education. The Training Committee's program will make it equally well known among employers.

The program of professional development originated by the Training Committee is being put forward at a particularly appropriate time. Mounting shortages of materials and man power confront the engineering profession with a task of enormous magnitude and importance. For both materials and man power must be utilized with intelligence, skill, and efficiency if this nation is successfully to superimpose a national-defense program upon its civilian economy. Neither materials nor man power can be wastefully or ineffectively utilized. Employers of engineers have a greater incentive than ever before to see to it that "the first five years of professional development" are constructively utilized by them and the engineering graduates who will be added to their staffs in a sound and effective upgrading process that will bring young men to full maturity in the shortest possible time and with the most fruitful results. Here is promise of a vital contribution of ECPD to the profession, industry, and the national welfare.

If for no other reason than the enthusiasm with which the proposals of the Training Committee were received, engineers will be disposed to give an affirmative answer to Dr. Rogers' questions, "Do you want this kind of an ECPD? Are you willing to provide for it financially—with money, and to supply it with strong representation—with men?"

DEVELOPMENT *of the* KINGSBURY THRUST BEARING

By ALBERT KINGSBURY



Albert Kingsbury

Albert Kingsbury elected Honorary Member — 1940

In June, 1880, I was graduated from the high school in the village (now city) of Cuyahoga Falls, Ohio, in a class of three boys and five girls—the first class formally graduated there—and later I studied for one year at Buchtel College, Akron, Ohio (later, University of Akron), in the Latin-Scientific course.

From 1881 to 1884, I was a machinist's apprentice with the Turner, Vaughn and Taylor Company, of Cuyahoga Falls, and was engaged mostly on rather rough heavy work, such as machines for working clay, wire drawing, etc. The experience there gained was of great value to me later.

In September, 1884, I entered The Ohio State University, Columbus, Ohio, as a freshman in the mechanical-engineering course. At the end of the sophomore year, being low in mind and funds, I took a job offered me by Prof. S. W. Robinson, of The Ohio State University, to work on a "wire grip" fastening machine of his invention and design, which was being manufactured by the Carver Cotton Gin Company at East Bridgewater, Mass. My work included drafting, inspection of the work at the Carver company, and trips to various shoe factories around New England to make repairs or alterations in the wire-grip machines already in use. After less than a year at this work, I became discouraged by certain features of the situation beyond my control and returned to Ohio. There I secured work with the Warner and Swasey Company, in Cleveland, as machinist, working mostly on 16-in. engine lathes and making parts for their regular line of machine tools, such as small turret lathes. At that time they were building the mounting for the famous Lick telescope (36-in. object lens) and it was my privilege to work on some parts of the mounting.

EARLY WORK IN LUBRICATION AT CORNELL

In the fall of 1887 I entered Sibley College, Cornell University, in the junior class in mechanical engineering, and continued there until graduation in 1889. In the latter part of the junior year arose the first of my experiences that definitely turned my thoughts toward the subject of lubrication, which has been the principal item in my lifework. The head of Sibley, Dr. R. H. Thurston, assigned to me the laboratory problem of testing the bearing metals submitted by the Pennsylvania Railroad Company. There were some five samples, in the form of half-bushings about 2 in. $\times 2^{1}/_{2}$ in., arranged for tests in a small Thurston oil tester. These samples had already been tested for wear in the laboratory at Sibley by students or others who had reported that some of the samples were much worse than others. I received no specific instructions for the tests, and so I naturally started by refitting all the samples carefully to the test journal by scraping. Then the samples were successively tested in the small Thurston machine, with varying loads, speeds, and oils, with the result that all the samples showed exactly identical results—*no wear* at all, though weighed in a delicate balance before and after test. I reported these facts to Dr. Thurston, who then suggested using kerosene, ordinarily not a lubricant. Thereafter certain tests showed a smaller coefficient of friction (0.0005) than had ever previously been found in any published report of bearing tests. Again Dr. Thurston offered no explanation. All this left me with a desire to find out something about the operation of oils in a bearing, since such tests could not explain the apparent mystery. The fact that the needed explanation had been published in 1886 by Osborne Reynolds in the Philosophical Transactions was not known to us at Sibley College at that time, though it was known to my former classmate, F. L. O. Wadsworth, at The Ohio State University, who about 1888 wrote an abstract of Reynolds' paper.

I pursued the studies at Sibley College from 1887 to 1889. About commencement time (1889) Dr. Thurston recommended me for a teaching job in the New Hampshire College of Agriculture and the Mechanic Arts at Hanover, N. H. The dean, Professor Pettee, invited me to come up and be seen, but I only

In 1942, the year before his death, Albert Kingsbury compiled some autobiographical notes entitled "Recollections," copies of which were distributed to members of his family and to a few business associates. By special permission these notes are here published for the first time. Certain personal references and extraneous matters have been omitted. The notes constitute Dr. Kingsbury's own story, in condensed form, of a lifetime spent in lubrication research and the development of the thrust bearing which bears his name.

Albert Kingsbury became a member of The American Society of Mechanical Engineers in 1892. He contributed technical papers on lubrication and bearings to its meetings and publications and served as chairman of the ASME Special Research Committee on Lubrication from 1915 to 1927. In 1931 he was awarded the ASME Medal "for his research and development work in the field of lubrication." He was elected an Honorary Member of ASME in 1940. Worcester Polytechnic Institute conferred on him, in 1933, the honorary degree of Doctor of Engineering and the University of New Hampshire, in 1935, the honorary degree of Doctor of Science. In 1923 he was awarded the Elliott Cresson Medal and in 1931, the John Scott Medal.—Editor.

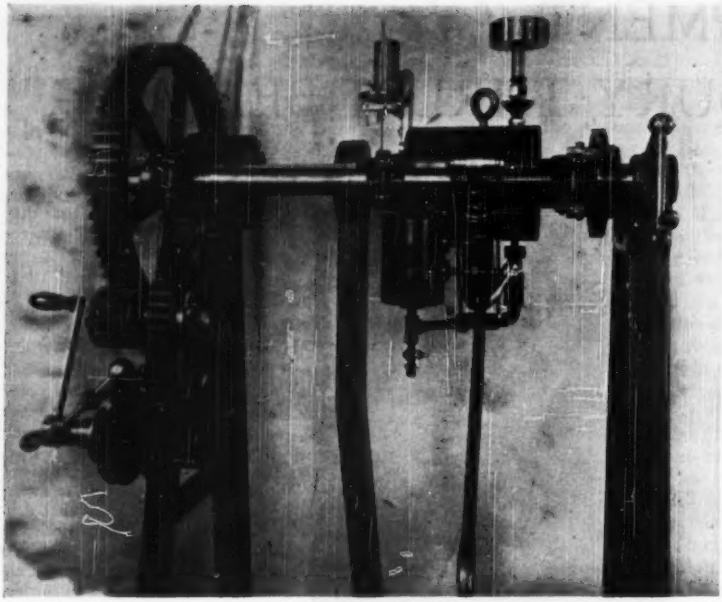


FIG. 1 TORSION-COMPRESSION MACHINE BUILT BY ALBERT KINGSBURY ABOUT 1892

[This machine was built to study friction in screw threads, particularly threads used in an action similar to that of a *jack screw*. The power head at the left was designed to furnish the twisting power or action to a sample placed between the power head and the weighing head at the top of the pendulum. The pendulum is the slightly bent member shown between the pump handle and the gear mechanism. The pendulum, the lower end of which is not shown, was bent back so that its center of gravity would be directly below the center of the support sleeve of the support (ball) bearing, thus eliminating any binding. A brass finger, just visible above the round bar connecting the two side frames, indicated the relative motion between the two heads. The modified steam-engine indicator is specially equipped with a stem which moves vertically as the center of gravity of the pendulum moves horizontally, and hence this movement is proportional to the torque applied to the sample. The cylinder to which the pump is attached contains a piston which, when under pressure, furnishes a thrust on the spindle which carries the pendulum. The pressure on the piston is measured by the pressure-gage testing unit mounted on the top of the cylinder at the right. The crank at the right was for the purpose of moving the whole weighing head in order to accommodate different lengths of sample. Thus this machine could subject a sample to a combination of twisting and compression and could weigh each of these actions independently.]

sent a photograph, promising to be on hand for the fall term. The compensation offered ($100 monthly) seemed huge to me after the years of study and work I had put in to pay the expenses of college life.

I had the teaching of the courses in mechanical engineering and physics with the assistance of John Brown as instructor in the machine shop, an excellent mechanic of the old New England type and an amiable man. There were also several instructors in woodworking; of these I remember best Allen G. Lowell and, later, George H. Furbish, as being very skillful.

There were, I think, 18 students in all during the year 1889-1890. At the close of the college year I resigned, having been offered a job by my highly esteemed cousin, Horace B. Camp, again at Cuyahoga Falls, Ohio, a very helpful man, much older than myself, of common-school education but of much experience in life. He had invented a brickmaking machine (among many previous inventions) and was bent on putting up a machine shop to manufacture it. He fancied that my good education should prove to be a great help to him in this matter. We erected a brick shop, 40 × 100 ft, equipped it with tools, and began business, I being the superintendent. However, after a few months, business did not develop as anticipated, and as Professor Pettee had always urged me to return to New Hampshire College, Horace finally advised me to accept the offer (a full professorship in mechanical engineering with salary of $2000 per year). So I returned to Hanover for the fall term, 1891, and retained the post of professor of mechanical engineering until July, 1899.

TEACHING AND RESEARCH

During the years 1891-1892, we of the faculty, especially Professor Pettee and I, were much concerned with the building of the new buildings for the College, at Durham, across the state from Hanover. We moved to the new location in 1893. While I was at Hanover, and at all times, my having charge of the shops gave me opportunity to continue my research in the questions about lubrication that arose in my junior year at Cornell, and I made a number of investigations, generally with a view to using the results as a means for instruction of the students. I rarely kept any record of these investigations.

First I built (mainly with the help of John Brown) a "torsion-compression" testing machine (Figs. 1 and 2). On this I made a long series of tests upon the friction of screws and nuts. These tests were the basis of a paper[1] I presented at the meeting of The American Society of Mechanical Engineers in New York, December, 1896.

The compression element of this machine, a piston 6 in. diameter and $6^1/_4$ in. long, fitted without packing of any kind to a heavy cylinder on which I had long meditated with doubt and mental questioning, proved to be not only entirely suited to the purpose but also a very interesting bit of mechanism in itself. I found that if piston and cylinder were taken alone, the axis being vertical, the piston could be spun rapidly, apparently without contact with the cylinder wall. Then John Brown found that the same action occurred even with the axis *horizontal*, and he called my attention to this. This was surprising, because the piston weighed 22 lb, being hollow and of trunk-piston type. I shortly came to the conclusion that this must be a case of lubrication, the *air* acting as the lubricant. After playing thus with these parts for some time, we made a new cylinder (Fig. 3) and a solid piston weighing about 50 lb, together with bits of apparatus to show the air pressure at various places in the air film in the space between piston and cylinder wall (mean space 0.0016 in.), and the variations in this space

[1] "Experiments on the Friction of Screws," by Albert Kingsbury, Trans. ASME, vol. 17, 1896, pp. 96-116.

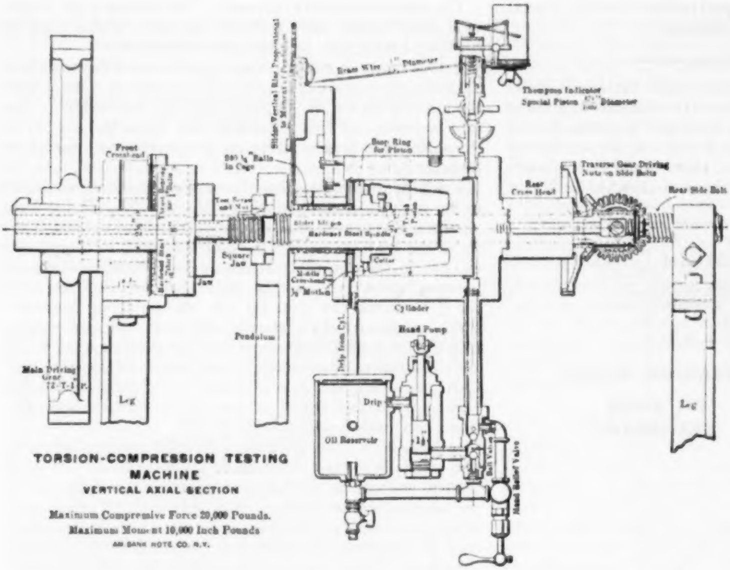


FIG. 2 SECTIONAL DRAWING OF TORSION-COMPRESSION MACHINE SHOWN IN FIG. 1

(Reproduced from Transactions ASME, vol. 17, 1896, p. 98.)

with the speed of rotation of the piston. This apparatus was exhibited before the Association of Agricultural Colleges at their meeting in Washington, November, 1896, and attracted much interest on the part of engineering teachers.

I then was invited to exhibit it before the engineers at the Bureau of Steam Engineering at the Navy Department, which I did. Among the listeners there was John H. MacAlpine (later well known because of his association with Admiral Melville in the promotion of the reduction gear). After my talk he went out and shortly reappeared with a big book in which he showed me that "Reynolds says this, while you said so-and-so." In fact, I *had* made an inaccurate statement in my brief notes. But this was my first sight of that remarkable paper by Osborne Reynolds[2] which explained for the first time in print most of the phenomena of lubrication that were shown in Tower's experiments[3] and also my puzzle of 1888 at Cornell.

On returning to Durham, I got the loan of the Philosophical Transactions from the Boston library, studied Osborne Reynolds' paper at length, and repeated my experiments with the air-lubricated bearing more fully in the light of Reynolds' theoretical work.

FIG. 3 AIR-LUBRICATED JOURNAL BEARING BUILT BY ALBERT KINGSBURY ABOUT 1892

[Six-inch-diameter cast-iron rotor has a wooden handgrip. A screw-driver slot is provided in end of shaft so that a screw driver in a hand or breast drill can be used to get high-speed rotation. The large knurled screw plug with wooden insert plug is used to vent the air space at the back of the cylinder. This allows insertion of the rotor and, when vent is closed, prevents withdrawal of the rotor. The smaller knurled screw plugs (five in number) are for insertion of micrometer measuring instruments so that clearance between the rotor and stator, i.e., thickness of the air film, can be measured accurately. The stator can be turned in the wooden support so that the micrometers can be oriented at any desired angle, thereby permitting measurement of air-film thickness at any position. This piece of apparatus is in regular use at Worcester Polytechnic Institute in classes in machine design and in lubrication studies.]

[2] "On the Theory of Lubrication," by Osborne Reynolds, Philosophical Transactions, 1886.

[3] First Report of the Research Committee on Friction: On Friction, Experiments (Friction of Lubricated Bearings, B. Tower, Proceedings of The Institution of Mechanical Eginneers, 1883, p. 632 and 1884, p. 29).

From this there resulted my paper[4] published in the Journal of the American Society of Naval Engineers.

PIVOTED-BLOCK THRUST BEARING

In reading the section of Reynolds' paper dealing with flat surfaces, it occurred to me that here was a possible solution of the troublesome problem of thrust bearings. Reynolds showed that if an extensive flat surface rubbed over a flat surface slightly inclined thereto, oil being present, there would be a pressure between the surfaces distributed about as sketched in Fig. 4.

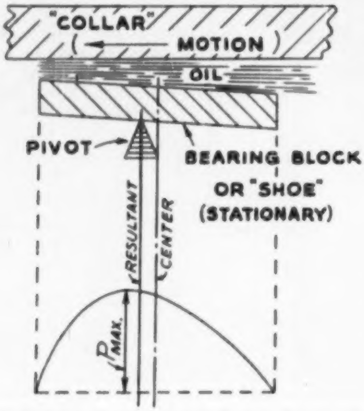


FIG. 4 ALBERT KINGSBURY'S SKETCH OF PRESSURE DISTRIBUTION IN OFFSET SHOE

The maximum pressure would occur somewhat beyond the center of the bearing block in the direction of motion, and the resultant would be between that maximum and the center line of the block. It occurred to me that if the block were supported from below on a pivot, at about the theoretical center of pressure, the oil pressures would automatically take the theoretical form, with a resulting small bearing friction and absence of wear of the metal parts, and that in this way a thrust bearing could be made, with several such blocks set around in a circle and with proper arrangements for lubrication.

I kept this idea in mind for a long time, but hesitated to make trial of it because the unit pressures that might be required, say, for the first long vertical shafts (1891) at Niagara Falls, where the pressure was 400–500 psi, were far beyond those familiar in existing thrust bearings that worked satisfactorily (for example, 40 to 50 psi in the bearings for ships' propeller shafts). Also, the requirement of the lopsided form of the bearing, apparently permitting rotation in one direction only, was a sticker. However, I decided to *try*, and in 1898 Mr. Brown and I built a bearing with the blocks supported *at the center line* of the blocks, and not on frictionless pivots, but on small spherical bosses projecting from the blocks. In 1898 I made tests of this bearing in the torsion-compression machine previously used for tests for friction of screws, with certain homemade roller devices to carry temporarily the reverse thrust of the bearing, and with a strip of sheet brass bent to catch the oil which was supplied in a small stream through the center of the bearing, as it was thrown from the rotating part.

[4] "Experiments With an Air-Lubricated Bearing," by Albert Kingsbury, *Journal of the American Society of Naval Engineers*, vol. 9, 1897.

The tests were entirely successful. The bearing loads, which were small at first, were gradually increased, finally reaching 4000 psi or more, the speed being about 285 rpm.

In 1919 I gave expression to my appreciation of Reynolds by a contribution to the University of Manchester to form at least the initial basis for an "Osborne Reynolds Fellowship." The first incumbent of this fellowship was Reynolds' son, F. D. Reynolds, who was working on the problems of the screw propeller.

It was my practice to give all reasonable teaching assistance to my students in thesis work, and for this purpose I utilized whatever research material I happened to have in hand at the time, the students paying the costs of small incidental materials. In the class to be graduated in 1898, were Moore and Morgan, who were building a small belt-driven electric generator (I furnished the ideas for the self-lubricating bearings). Colby and Kenney of the class of 1899 made tests with varying clearance on a small steam engine (using parts arranged by me and a hydraulic dynamometer of my design and construction). Clement worked alone on a design on a small vertical steam engine; Baker and Putney on tests of the thrust bearing that I had previously tested (1898).

In July, 1899, I left my post at New Hampshire College for one at the Worcester Polytechnic Institute where I was appointed professor of applied mechanics and had charge also of the laboratory where material tests were made. I gave lectures and other instruction, but also spent much time in the laboratory, in classwork, and in my personal research in lubrication especially. There were two tension-testing machines and a large torsion machine (at Worcester Polytechnic Institute), but nothing else.

I shortly made a deal with Dr. Murkland, president of New Hampshire College, whereby my old torsion-compression testing machine and all the test-pieces used in it, and some other pieces, including the thrust bearing, were transferred to Worcester. At Worcester, I also had constructed a small machine for journal friction tests, Fig. 5, which proved to be quite interesting and instructive to me as well as the students.

Among the students preparing theses for graduating in 1900 were Graffam and Traill, who made, at my suggestion, a new base or support for the shoes of the thrust bearing, with long radial supports of cylindrical form for the shoes. These students made very successful tests of the new bearing.

In these tests, as well as in those of Baker and Putney at New Hampshire, the good operation with "central supports" for the shoes was not explained by the theory of Reynolds, who assumed constant viscosity in the oil. It was explained in later years by H. T. Newbigin, then manager of the Michell plant, who suggested that, because of the continuous friction heating, the oil became less viscous as it passed in the film from the leading edge to the trailing edge of each shoe; and this appears to be the main explanation. The idea of "central supports" was afterward patented in England by Cooke, who was associated with the Hon. Charles A. Parsons in the steam-turbine business. It was probably not known or recognized by anyone that I had used the idea in my very first bearing in the United States, and of course I offered no objection to the British patent as I did not hear of it until the patent was issued and it did not affect my work.

I later used this idea extensively, and still use it, in my American practice.

The Graffam and Traill construction introduced a new difficulty which arose from the lack of radial tipping of the shoes, so that, because of bending of the support, much scraping was required to make the shoes fit the rotating disk. Graffam later wrote me a suggestion which probably, if used, would go a long way toward meeting the difficulty, but it was never tried, as

other and better ways were used by me originally and later. The same suggested improvement was also proposed to me by Putney in 1909.

TEACHING ABANDONED FOR ENGINEERING WORK AT WESTINGHOUSE

In June, 1903, through the good offices of B. G. Lamme, my old friend and classmate at The Ohio State University, who was shortly to be chief engineer of the Westinghouse Electric and Manufacturing Company, I got employment at the East Pittsburgh works as a "general engineer," working mostly on mechanical matters because I was not very well versed in electrical matters. Notwithstanding this, when a call came from the Canadian Westinghouse Company for an electrical engineer, I was sent to make a report to the Canadian Pacific Railway on the electrical equipment installed by the General Electric Company at various places on their system. I protested that I was not an electrical engineer, both to the Westinghouse people and to Sir Thomas Shaughnessey, then president of the Canadian Pacific Railway. I spent two or three months in the summer of 1904 on this work at Montreal, Winnipeg, and Port Arthur, with results that apparently satisfied all concerned. Also, I learned much about electric motors from the tests I found necessary.

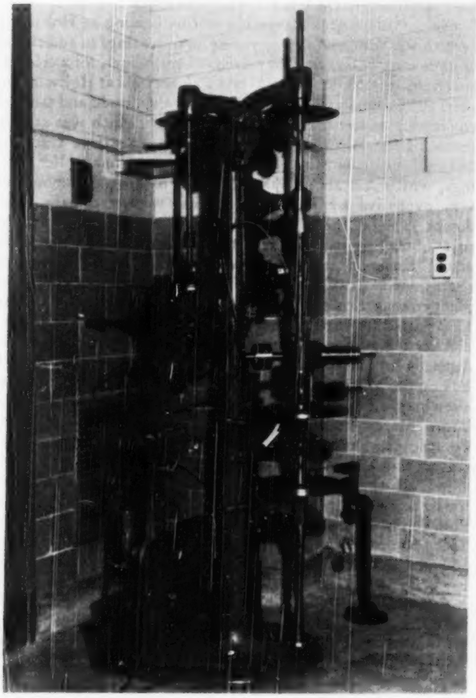


FIG. 5 JOURNAL-BEARING LUBRICATION TESTER BUILT BY ALBERT KINGSBURY

[The stand is made from a Washburn Shops, Worcester Polytechnic Institute, friction-drive variable-speed sensitive drill press, slightly modified from the original as first built by Kingsbury. The spindle and weighing device are just as originally designed, however. The cup which contains the bearing shoes and the lubricant is shown above the circular table. The hand screw on one side of the cup varies the pressure on the bearing and the pressure is indicated by an indicator on the barrel. The counter weight opposite the pressure screw balances the unit so that it hangs freely. The bearing unit extends nearly to the base of the stand, by means of a hollow tube, and the support is by means of a wire or torsional spring which comes back up to the bracket just under the bearing cup. The bearing rotor is at the base of the spindle to which it is connected through two universal joints. Lubrication characteristics for various lubricants under varying pressures and temperatures were investigated in this machine. The machine is used as regular laboratory equipment at W.P.I. and has been so used for many years.]

When I returned to East Pittsburgh I was given work on the mechanical design of the rotors for turbine-driven generators which involved high rotative speed and, therefore, high mechanical stresses. I continued with the Westinghouse Electric Company until 1914, being a consulting engineer for them and for the Westinghouse Machine Company (near by) during later years. About this time I set up as consulting engineer on my own account, with an office in the Oliver Building, Pittsburgh.

ATTEMPTS TO DEVELOP THE THRUST BEARING COMMERCIALLY

During my work at East Pittsburgh I missed no chance of promoting my old idea of the thrust bearing with these two companies. In 1904 the Electric Company had to build a large electric motor with a vertical shaft, and for this motor they made, at my suggestion, a thrust bearing of my type. This was installed in the motor for "shop test." The test run was made at night, without my knowledge and attention, and the bearing was reported to have "run hot" and was, therefore, discarded. I never saw it again. It was replaced by a ball bearing, as originally intended. I could realize from later experience why my bearing "ran hot" in this case. Firstly, it was much too large for the job, being designed for a load of only 50 psi (400 would have been better), and secondly, the speed was quite high, 750 rpm. Probably the oil was unsuitable also, perhaps too viscous for this case. But the drawing of this 1904 bearing, being the only one then available, was used with my application (1907) for a United States patent.

In 1909 the Electric Company built a large vertical motor for the Minidoka irrigation project in Idaho. This motor was provided with a ball-bearing thrust. The company had sent an engineer to look over the plant and the products of the bearing maker in Philadelphia and he had reported favorably on the plant and products, but when the motor was subjected to shop test for a day or two, I found that the ball bearing already showed indications of incipient failure. I, of course, reported this to H. P. Davis, vice-president and manager of engineering, asking that one of my designs be tried instead. He would not consent to this trial except at my personal expense for the parts required. Accordingly, the works made, at my cost, a bearing to replace the ball bearing, working from my free-hand sketches and notes which, I remember, were very crude indeed. This was ready and tested under my supervision in about a week and it operated perfectly. But the attitude of the Company officials who viewed the operation seemed to be "there ain't no such animal," and the bearing was therefore rejected and the motor was finally equipped with a roller bearing before being shipped to Idaho.

Some 14 years later the U. S. Army Engineers at the plant in Idaho applied to me for a bearing for this motor to replace the roller bearing, and this I furnished them. I suppose I have heard the last of that particular job. My bearings appear to last indefinitely long in service, since those installed 30 years ago are still operating well.

About 1906 I told Mr. Davis that if the Electric Company would obtain a patent and would develop the bearing to the point where they could determine its value, they could then

own the patent by paying me what they thought proper for it. Hence Mr. Davis had the Legal Department start an application, through R. J. Dearborn, of that department, who had been one of my students at Worcester Polytechnic Institute.

Before long this matter came to the attention of the president, then E. M. Herr, who did not approve it; so I had to bear further expense myself. The patent application was filed in 1907. The first action of the Patent Office was a denial, because of Michell's patent on the same idea in England, issued in 1904. Thereupon, Dearborn filed for me affidavits of Baker and of Putney, and later those of Graffam and of Traill, which established my precedence of a few years in the matter. As a result, the Patent Office granted me a patent, No. 947242, issued in 1910.[5]

During 1910–1911 the Westinghouse Machine Company became interested in the thrust bearing, through H. T. Herr, vice-president, and Francis Hodgkinson, chief engineer. Before taking the license I proposed, they made, in their works, extensive tests of the bearing applied to a high-speed steam turbine (3600 rpm). The bearing worked very well and the bearing area was reduced in successive tests until the babbitt-metal facing was crushed by the pressure (7000 to 8000 psi). This surprising result convinced them, so they took the license (my *first one*) and continued to work under it through the life of the patent.

A few years later, the Westinghouse Electric Company also took a license for their own work, and in later years other manufacturers took licenses. These later licenses contained a restriction as to size (100 sq in., or less, of shoe area) because it had seemed to me for a long time that relatively moderate sizes were easy to make and install, since the only difficulties I had met occurred with larger bearings (48 to 61-in. sizes) and I preferred to keep the large sizes for my own manufacture and installation.

IN BUSINESS FOR MYSELF

Early in 1912 the Pennsylvania Water and Power Company gave me a chance to apply a bearing in their hydroelectric plant at McCall's Ferry (now called Holtwood) on the Susquehanna River, where they had had much trouble with the original roller bearing supplied by a Philadelphia concern. The load to be carried was about 200 or 250 tons and the speed, 94 rpm. I made a drawing of the bearing and showed it to H. T. Herr, asking if the Machine Company could build it for me. This they consented to do under my direction, on being assured that I could pay for it. This happened just at the time when a $5000 twenty-year "endowment" insurance policy, that I had assumed in 1892, matured. I have always advised young men to follow my example, because this matured policy gave me a really firm start in business, and I did not have to borrow money.

I signed a contract with the Pennsylvania Water and Power Company (a very stiff one, from my point of view) and got the bearing made and installed. On the first trial run the bearing failed at once and completely by the "wiping" of the babbitt metal of the shoes; the cast-iron disk or "runner" was merely scraped, not polished. I explained to the company what I thought to be the reason for the failure and had the parts shipped back to East Pittsburgh. After properly polishing the runner and pouring new babbitt metal on the shoes, the bearing was replaced in the 10,000-hp unit at Holtwood. After several days and nights of work at refitting the babbitt surfaces, further trial runs were made, with complete success, and the unit was put in service again.

I had worked day and night with the gang on the job and was not without discouragement. On one of the last nights, as I emerged from the powerhouse at 2 or 3 o'clock in the morning, intending to go to bed at the boardinghouse about 400 ft up the hill, all my sentimentality was awakened by the sight of the great planet Jupiter, hanging like a huge torch above the dark valley. No sound could be heard except that of the rushing river. This experience gave me renewed inspiration, and I shall never forget the scene.

The continued good operation of this bearing at Holtwood (which was followed there by nine more bearings in additional units in later years) was the reason, 25 years later, for a celebration of its installation in 1912. At a dinner held at Holtwood in July, 1937, attended by Mrs. Kingsbury and myself and most of the officers and employees of the Company, much was said in praise of the bearing, which really seems to have been the financial salvation of the Company. (The original roller bearings, which cost about $5000 each, required a vast amount of very expensive servicing and repairs, with expensive shutdowns.) After the dinner we saw, in the power plant, the parts of my original bearing, removed for inspection, and made actual measurements of the amount of wear on the blocks (or shoes)—at most 0.005 or 0.006 in. near the trailing end. The plant engineers calculated from this a "probable life of 1300 to 1700 years" for the bearing.

After the success at Holtwood in 1912, there were frequent demands for the bearing for hydroelectric generators, at Keokuk on the Mississippi, Cedars Rapids on the St. Lawrence, and elsewhere. I had working arrangements with the Westinghouse Machine Company and the Canadian Westinghouse Company to build bearings for me, as required. Up to 1918 this work was done largely for the U. S. Navy.

In 1921 the Machine Company found that they could no longer keep up my work. I had at the time a small shop in Philadelphia (on Cherry St.), but soon bought an old plant on Tackawanna St., Frankford, in the northeast part of the city, and new and second-hand machine tools for equipment, and began to manufacture bearings there. Soon more space was required and was built there, and I am now (August, 1942) again building additional space, to accommodate the great amount of work under way for the U. S. Navy in the present World War.

The U. S. Navy began to use my bearing on propeller shafts in 1917, although I had much earlier tried to get the Bureau of Steam Engineering interested. I have been told (by someone I cannot now identify) that it was the fact that the British Government was using the Michell bearing that caused the U. S. Navy to adopt my bearing. Even then the head of the Bureau, Admiral Griffin, who apparently assumed that I was an interloper, asked Admiral Dyson to check up on this matter. Dyson reported to him, and also to me, that I had a perfectly good U. S. patent. After that the contractors for Navy ships used the bearings in large numbers, so that it took some 10 to 12 machine shops, in addition to the Westinghouse plant, to supply the demand during the remaining years of the first World War.

However, we met the demands with no delays and we are now again continuing to do so in the present World War, for our plant in Philadelphia is loaded to the limit, and about eight outside plants are helping us.

[5] In a paper presented at a meeting of the ASME Metropolitan Section in New York on May 17, 1929, "Progress of Fluid-Film Lubrication" (Trans. ASME, vol. 51, 1929, paper MSP-51-21) A. G. M. Michell said: "In this connection the author avails himself of the opportunity to explain that the pivoted thrust bearings known in America and Europe respectively as the 'Kingsbury' and 'Michell' bearings are in principle the same, and to state that the development of these bearings was effected in its early stages by Professor Kingsbury and himself independently in their respective countries without knowledge of each other's work. Professor Kingsbury's work was commenced a few years earlier, though his first publication on the subject was later than the author's."—EDITOR.

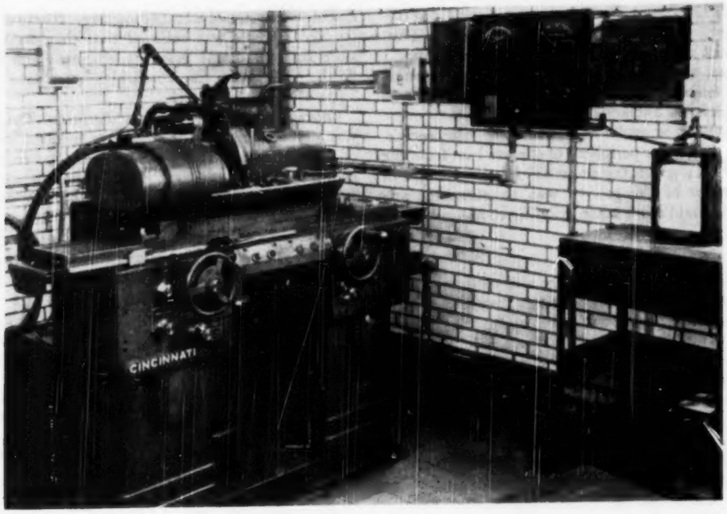


FIG. 1 CINCINNATI MODEL OH 4-IN. × 12-IN. PLAIN HYDRAULIC CYLINDRICAL GRINDER

GRINDING FLUIDS

A Method of Measuring the Metallic-Wheel-Loading Characteristics

By L. H. SUDHOLZ,[1] S. MANILYCH,[2] and G. S. MAPES[3]

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INTRODUCTION

IN the operation of a grinding wheel, the efficiency decreases as the wheel face becomes dull. This dulling may be caused by the abrasive points wearing down to "flats," in which condition they do not remove metal readily, or it may be caused by loading of the grinding wheel. This loading may be of two types, gum loading or metallic loading. The former occurs when the grinding fluid deposits a gummy material on the surface of the wheel. This difficulty usually can be eliminated by choice of the correct grinding fluid. The second type, metallic loading, might be described as that condition wherein the pores of the wheel become filled with metal particles, leaving no space for chip clearance. This discussion is limited to the latter type of loading.

In an evaluation of the efficiency of a grinding operation, measurement of the power consumption usually is conducted. While this is an important determination, it includes the effects of both the wearing of the points of the abrasive and the metallic loading of the grinding wheel. Accordingly, other means are required to differentiate between these factors. For this purpose a method of recording and measuring the degree of metallic wheel loading was developed.

DESCRIPTION OF TEST EQUIPMENT

The machine tool used in this experimental study was a Cincinnati Model OH 4-in. × 12-in. plain hydraulic cylindrical grinder, shown in Fig. 1. In order to insure constant surface speeds for the grinding wheel and the workpiece, with variations in diameters, the wheel head and headstock were equipped with variable-speed direct-current motors. Tachometer generators were installed on the grinding-wheel spindle and the headstock drive, in order to indicate respective speeds.

For the purpose of facilitating rapid change of coolants during the various evaluations, a 25-gal tank was constructed and installed outside the grinder. It was equipped with two compartments separated by a slotted baffle in order to confine the turbulence, created by the return flow, to one section. This permitted more rapid settling of the fines. A pump was installed in the reservoir to supply the wheelwork contact area with sufficient coolant at a constant rate.

The A80M5VBE wheels, 16 in. × 1 in. × 8 in., used in the investigation, were manufactured and specially selected by the Norton Company.

CHARACTERISTICS AND PREPARATION OF STEEL WORKPIECES

Two types of metal were used in this investigation. The first type consisted of SAE 1020 steel, hot-rolled, having an

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average hardness of 120 Bhn. The other was a Type 416 stainless steel, annealed, with an average hardness of 215 Bhn. The latter contained approximately 13 per cent chromium, 1 per cent manganese, and 0.15 per cent carbon. These metals were supplied on special order to eliminate any variables in composition and physical characteristics.

The workpieces were 1 in. in diam and 6 in. long. A $^1/_8$-in. × $^1/_8$-in. groove was cut on the periphery of the bar 1 in. from the headstock end, thereby providing an actual grinding length of $4^7/_8$ in. The purpose of the groove was to eliminate any corner wear which would occur when grinding to a shoulder.

TEST PROCEDURE

The development of this test procedure was undertaken primarily with the objective of establishing an accurate method of recording and measuring metallic wheel loading, which could be used in the evaluation of grinding fluids. All variables in the test procedure, including characteristics of the test metals and the grinding wheels, were maintained at a minimum in order to insure accurate evaluation of the various grinding fluids.

Operating Conditions in Grinder. Obviously, in order to compare the relative metallic-wheel-loading characteristics of various grinding fluids, it was essential that operating conditions be selected which would permit appreciable metallic loading. Accordingly, an attempt was made to accelerate the development of this condition without departing radically from field operating conditions.

In establishing preliminary test conditions in the grinder, the metal selected was SAE 1020 steel previously described. The rate of coolant flow was established at 6 gpm and an A80M5VBE grinding wheel was selected. This type of grinding wheel was believed to be more suitable than one with coarser grains since it would tend to induce appreciable metallic loading.

After considerable experimentation with various combinations of work and wheel speeds, traverse rates, and infeeds, it was established that these conditions should be maintained as follows:

Grinding-wheel speed, sfm	6000
Work speed, sfm	130
Table traverse, ipm	27
Infeed, in. per pass	0.003

Prior to the actual grinding of the test metal, the grinding wheel was dressed carefully with the use of a sharp 1.10-carat diamond. In this dressing operation the table-traverse rate employed was 64 ipm, and the infeed 0.001 in. per pass. The number of passes for a complete dressing of the wheel was dependent upon the amount of removal required to present a square free cutting surface containing no metallic inclusions. The absence of metallic inclusions in the newly dressed wheel was established by the chemical detection tests subsequently described. It was found that 30 passes were required to eliminate all of the metallic particles.

In the actual grinding operation, the test bar was placed between centers and the grinding wheel advanced into light contact, or "sparked in" at one end of the bar. A total of ten passes was then made using the semiautomatic infeed with the conditions tabulated previously. Upon completion of the tenth pass, the wheel was withdrawn from the work and not permitted to "spark out."

Following this grinding procedure, the entire periphery of the wheel was examined for evidence of metallic loading. Since the distribution of the metallic particles was not uniform, two different portions of the wheel surface which appeared to exhibit maximum loading were selected for subsequent recording and measurement of metallic loading. These critical areas were selected since it was believed that they were largely responsible for the actual grinding efficiency and resultant surface finish. The same test conditions were used in grinding the Type 416 stainless steel.

Chemical Detection of Metallic Particles. Originally, an effort was made to record the degree of metallic loading by means of photographs. This procedure was not entirely satisfactory because only a small area of the grinding wheel would be in focus, and hence the resultant photograph would not give a true indication of the actual degree of loading.

Subsequently, an investigation was made regarding the feasibility of counting the metallic particles directly on the surface of the wheel. This procedure proved to be both impractical and inaccurate.

Accordingly, development of a chemical detection method was instigated with the objective of recording the actual metallic-loading images on paper in order to evaluate accurately grinding fluids with respect to this characteristic.

In this procedure, Eastman Kodak "imbibition" paper, grade F, double weight, gelatin coated, was found to be most satisfactory in the preparation of metallic images. This paper was cut into 2-in. squares and saturated with a dilute (1-9) solution of hydrochloric acid for 1 min. The excess acid was removed from the surface of the paper by means of an absorbent material. The impregnated paper was then placed in contact with the selected area of the wheel surface, and pressure was applied thereto by means of a 2-in. × 2-in. cardboard square. After 5 sec, the paper was removed from the surface of the wheel and developed by immersion in an aqueous solution of 2 per cent potassium ferrocyanide and 2 per cent potassium ferricyanide. After a short period of time, reactions took place and the blue images of the metal particles appeared. After the images were defined clearly, the print was washed in tap water and dried.

The chemical reactions involved in the development of the images were as follows

The hydrochloric acid in the imbibition paper on contact with the metallic particles on the wheel formed ferrous chloride and/or ferric chloride. These salts reacted with the developing solution as follows

$4\ FeCl_3$ (ferric chloride)	+	$3K_4Fe(CN)_6 \rightarrow$ (potassium ferrocyanide)	$Fe_4(Fe(CN)_6)_3 + 12\ KCl$ (Prussian blue)
$3\ FeCl_2$ (ferrous chloride)	+	$2KFe(CN)_6 \rightarrow$ (potassium ferricyanide)	$Fe_3(Fe(CN)_6)_2 + 6KCl$ (Turnbull's blue)

It will be noted from the foregoing reactions that blue spots should appear on the prints corresponding to the steel particles embedded in the grinding wheel.

Measurement of Metallic Particles. An O. M. Type Brinell microscope was found to be suitable and accurate for measuring metallic-wheel-loading impressions which were recorded on imbibition paper. The tube of the microscope was fitted with a scale divided into tenths of a millimeter. Furthermore, the particles were magnified 10.7 times, thus facilitating accurate readings.

Each wheel impression print (2 in. × 1 in.) was inspected visually and the 1-sq-in. portion, showing the greatest concentration of loading, was examined under the microscope. The total number of particles per square inch was determined at two different positions where maximum metallic loading was apparent. The average number of particles determined from these prints represented the maximum degree of loading.

In establishing this test procedure, it was essential that the limits be defined with respect to both particle size and number.

The particle size was important in order to facilitate ease of measurement and counting. For the purpose of determining these limits, impressions were taken from a freshly dressed wheel, and then, from a wheel which had been loaded metallically to a maximum extent when using any grinding fluid. It was concluded therefrom that only those particles having a minimum dimension of 0.5 mm should be included, those smaller in size being too numerous for accurate count. These tests also defined the range of particle concentration since the newly dressed wheel showed practically no metallic wheel loading, while the grinding wheel used with tap water indicated the maximum obtained with any grinding fluid.

In the case of a newly dressed A80M5VBE wheel (0.030 in. removed), no metallic impressions, having a minimum dimension of 0.5 mm, are present. Fig. 2 indicates the maximum loading conditions which occurred when tap water was used as the grinding fluid.

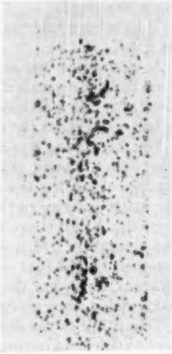

FIG. 2 MAXIMUM LOADING—TAP WATER

Finish. It was noted that as the metallic wheel loading of a grinding wheel increased, the finish of the workpiece became inferior. When tap water was used as the grinding fluid, appreciable loading occurred, and actual gouging of the work surface resulted.

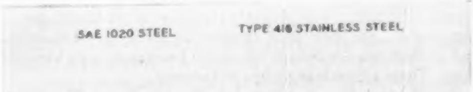

FIG. 3 SPOT IMPRESSIONS REPRESENTING METALLIC LOADING WITH VARIOUS GRINDING FLUIDS USING AN A80M5VBE GRINDING WHEEL

EVALUATION OF PRODUCTS

Results of metallic-wheel-loading evaluations of several types of cutting fluids are shown in Table 1. These products were tested at emulsion concentrations of 1–50 and 1–100.

It will be noted from Table 1 that soluble oil A, a heavy-duty

TABLE 1 EVALUATION OF GRINDING FLUIDS

Product	Maximum metallic wheel loading, number of particles per sq in. (0.5 mm minimum dimension): SAE 1020 steel	Type 416 stainless steel
	1–50 Dilution	
Soluble oil A[a]	12	14
Soluble oil B[b]	18	14
Soluble oil C[c]	25	18
Experimental nonpetroleum water-soluble cutting fluid	20	24
Commercial product A[d]	28	32
Commercial product B[d]	32	34
	1–100 Dilution	
Soluble oil A[a]	21	17
Soluble oil B[b]	23	18
Soluble oil C[c]	29	22
Experimental nonpetroleum water-soluble cutting fluid	25	27
Commercial product A[d]	36	37
Commercial product B[d]	37	43
Tap water	83	68

[a] Heavy-duty soluble oil, high in oiliness and EP characteristics.
[b] Conventional-type soluble oil.
[c] Conventional-type soluble oil forming translucent emulsions in soft water.
[d] Nonpetroleum water-soluble cutting fluid currently marketed commercially.

product, was superior to all of the other grinding fluids, including the nonpetroleum type, on both metals. Soluble oil B, the conventional type, while not as satisfactory as the heavy-duty product, was quite efficient and effected appreciably less metallic wheel loading than the nonpetroleum grinding fluids. The extreme conditions of wheel loading occurred, of course, when tap water was used as the grinding fluid.

Previous results of grinding investigations indicated that the power consumption and wheel wear, effected with the use of certain grinding fluids, varied as the degree of metallic loading. Further work is now in progress to confirm this relationship, and it is expected that these data will be reported in the near future.

The spot impressions, shown in Fig. 3, indicate the metallic-wheel-loading conditions which resulted when grinding SAE 1020 and Type 416 stainless steels with the use of some of the grinding fluids listed in Table 1. The actual photographs of these loading conditions were not included since, as mentioned previously, only a small section of the wheel was in focus owing to the curvature thereof, and, accordingly, a true indication of the degree of loading was not obtained. Furthermore, in some cases, the metallic particles were difficult to detect by photographic inspection because of slight staining or discoloration.

As indicated in Fig. 3, soluble oil A, the heavy-duty type, showed the least metallic loading. Soluble oil B, the conventional type, indicated slightly greater loading, while commercial product A, the nonpetroleum water-soluble cutting fluid, showed the greatest degree of metallic loading. In each case the loading tendencies were increased with greater dilution of the product.

Any discrepancy between metallic-particle count and spot

(*Continued on page 983*)

MACHINE DESIGN *as a* CAREER

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MANY young engineers are reluctant to take up design as a career. There are many reasons for this reluctance, some being valid and others invalid. It is the purpose of this paper to discuss this general situation.

ASME MACHINE DESIGN DIVISION

Section 5 of The American Society of Mechanical Engineers' Constitution, By-Laws, and Rules reads as follows:

"A member shall be an engineer or teacher of engineering who shall have had eight years of active practice in the profession of engineering or teaching, three years of which shall have been in a position of responsible charge of engineering work and who is qualified to direct such work, *or to carry on important research or design in the field of engineering*. Graduation from a school of engineering of accepted standing shall be considered equivalent to four years of active practice."

You will notice that this Section 5 specifically mentions design in the field of engineering. The italics are the author's.

Why, then, has it been difficult to induce engineers to take up design as a career? There are many reasons. One deals with the emphasis formerly placed by The American Society of Mechanical Engineers on the various branches of mechanical engineering. For a long time, the Society was criticized because it leaned too heavily toward the power-plant field. Then, other divisions increased their representation, and now there seems to be a fairly large number of divisions of great importance. For example, at the present time three of the very strong divisions are Applied Mechanics, Heat Transfer, and Management.

Until a few years ago, however, there was no division devoted to machine design, although machine-design activities had been handled as a subdivision of the Production Engineering Division. Because of the crying need for a separate group to handle machine design, such a group was set up with an organization meeting held in New York in December, 1945. This group got under way and took an immediate hold upon a fairly large percentage of the membership of the Society. The interest was so strong that within one year the group was converted into a full division of the Society, and the division has grown rapidly, with an increasing number of papers being presented yearly, and a growing backlog. Why?

Well, almost every engineer has to do some designing in his life, and a very large percentage of engineers are connected with design somehow or other most of their lives. This may or may not be in the actual designing. It may be that, as an engineer, he would be asked to analyze mechanisms, or he may be in a supervisory position where machine design is being done. But, at least, he has some connection with machine design.

ON THE BOARD

In many companies all new productions are prepared by machine designers. Research is often performed by machine designers, and their work in any organization is always considered important, but the young engineering graduates are still not attracted to design. In industry the author had frequently discussed with prospective employees the openings available. Almost invariably they would ask if the position would be on the drawing board, and they generally added something like this:

"I have been told that once a man is on the board, he is there for life."

At that point, the author would bring out the organization chart for the research division of the company in question and show that the statement certainly did not apply in that case. In fact, in so far as the author knows, it seldom applies.

Yet the feeling was so great it was only in an exceptional case that a young engineer could be persuaded to go into machine designing as a career, in spite of the fact that this was the major activity of the particular corporation. To some extent, this belief is probably traceable to the experience of the last generation. Men who were hired as draftsmen and became designers stayed that way, but an analysis of the situation indicates clearly that they were not engineers as we know them today; also, they probably were competent designers.

This is one of the difficulties which must be faced. It is not easy to define an engineer in satisfactory terms. Very often, at two adjacent desks, there may be two men doing machine design—one of the men a college graduate, and the other man who may not have gone through high school. Yet they are doing comparable work, and on the face of it might have comparable futures. However, it is perfectly clear that if the futures can be comparable, the two men themselves must be comparable; and in that case the college education has merely equalized the men. There are such engineers in industry.

We all know that, in all probability, the lowest 25 per cent of the men graduating from college will not make too great a success in the technical phases of engineering. In some cases there are extenuating circumstances for the low grades, and such men may do well. But, on the average, the lowest men graduating from an engineering college might be expected to have a limited ceiling in technical engineering. We are also aware that there are many men who did not go to college who have very keen minds, and many have very fertile imaginations. Many such men are far superior mentally to many college men. The best engineer the author ever met was a man who had a quite limited formal education, but he was a brilliant character and had several hundred patents in his own name in this country alone. When he decided to make a design for a particular machine, there was no question in anybody's mind that the thing would work. Indeed, it was largely because of his efforts that one of the major industrial companies in the country has been built.

COLLEGE VERSUS NONCOLLEGE MEN

If the man without college training is really better equipped mentally than the man with college training, it is only natural to assume that the one with college training might grow disgruntled at his lack of progress, but this is not because he chooses design. It is because he is not the proper man for the job. On the other hand, if there are two men at adjacent desks who are apparently doing the same design work, each with about the same native ability, but one with the superior mental training which comes from a rigorous college engineering course, then there is little question in the minds of the average management which of the two men would be promoted

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when the occasion arises. This is very evident in industry today. There is a continuous increase in the management ranks of the percentage of college-trained men. In most such management positions, there is a definite connection with machine design a large part of the time. Thus a firsthand experience with design would stand such a manager in good stead. He would know the limitations of designers; he would know what could or could not be done, on the average; and, as a manager, he would be more valuable than the theoretical man who had never rubbed his nose specifically in the problem.

Almost all young college graduates are impatient to get ahead. They expect within a few years that they will be managing the concern, and when they are not promoted fairly quickly they feel that they are being slighted. It is obvious, of course, that all men can't be promoted. If, for example, there is a machine-design group of perhaps 40 or 50 men, ordinarily there would be only one boss with perhaps an assistant or two, so that if all men who went into that organization were college trained, clearly many of them would be dissatisfied after a long period of time. But that situation seems, in general, to have no immediate prospect of arising. During the past 15 years the author has been watching the training of designers, and has found a most remarkable thing. There seems to be almost zero correlation between advanced training and inventiveness. The percentage of college graduates with inventive ability is no higher than for noncollege graduates who have taken up design as a career. In several organizations most of the inventions are made by noncollege men. The author has no way of knowing what effect, if any, the college had on this. It seems unlikely that the college had stultified the mentality of the man; but, on the other hand, it is possible that college training, in general, does not improve a man's inventive ability, although it does improve his ability to analyze an invention, and would prevent him from making, and pushing, certain inventions that are scientifically unsound.

Realizing these facts, some large design organizations have separated the activities of the engineer and the designer. In either case the man may, or may not, be college trained; but in almost every case the designer is a noncollege man, and the engineer is a college-trained man. The designers in such an organization would make the designs which would be turned over to the engineers, each of whom would develop a specialty of some sort, and every part of the design would be analyzed to see that it was theoretically correct.

For example, with a typical reasonably complex design there would ordinarily be gears, perhaps cams, mechanisms, stresses, materials, electric circuits, vibration problems, motion-time analyses, and safety features, all to be considered. Now if the Engineering Department has a specialist in each of those fields and makes a complete analysis, then the design probably would be better after the engineers get through than before, and the designer could accept the recommendations of the Engineering Department and could improve his mechanism. But if that designer had been a college man in the first place, some of the work of the engineers could have been done by him. This, automatically, would bring him forcibly to the attention of the management, and immediately he would be in line for promotion, if he had the added ability to guide men. There is no thought in the minds of the average employer today of promoting a man to a position of executive or administrative type merely because he excels in his job. It would be unwise policy to promote the best machine designer to take over a machine design section unless he had the other qualities necessary in management. Many of the designers fail to see this, and, frequently, they are disgruntled when they see a young college graduate, who can't design machines nearly as well as they, being promoted and put above them. One point which they sometimes fail to realize is that their salary may be higher than his. It is being realized in industry today that the boss is not necessarily the most important man in the group, and he certainly should not always be the best paid, although he generally is.

In one large organization three of the highest-paid men are machine designers working on the board. They are extremely valuable, are not well trained in a formal technical sense, but ingenious and practical. It would be a greater loss to the company to have any one of them go than to have the supervisor go. On the other hand, they would make abominable supervisors, although they do not realize it.

Effects of Immigration Changes

In the first twenty years or so of this century this country relied, to a large extent, on the importation of skilled men from Europe to do many of the things necessary in industry. Among the skilled men were toolmakers, mechanics, cabinetmakers, machinists, draftsmen, and designers; and, to a large extent, the development of such men within our own ranks was not pushed. This has proved to be a costly mistake, and during the war it was almost impossible to get an adequate supply of trained men. Everyone needed them, and they just were not available. Many progressive large organizations have thus reached the conclusion that they must train their own designers. They will pick out a large flock of young men, who, apparently, show some interest in machine design and give them training in drawing. Some of these men may have been messenger or blueprint boys; but if they show evidence of interest and skill at the end of a training period, they are encouraged to go on with drafting—first of all, of course, detailing, and later doing simple design. If they still show promise, they are given more and more responsible work; and, eventually, they can be classified as layout men or even designers.

The college graduate would not ordinarily go through such a long training period, but there is a great need for a man who can combine the knowledge of the engineer with design training. The author once tried to get an engineer, who had shown design talent, to go on the board for a while, with the expectation that rather soon he would be in line for promotion. He agreed, reluctantly, to do so, but after a few months, during which time he produced a very creditable piece of work, he asked to be relieved of his tentative agreement since he felt that promotion would be more rapid if he were not on the board. Actually, that man has been promoted quite rapidly, possibly more rapidly than if he had been on the board, although this is not clear; but his future in engineering is not so secure as if he had had design experience for a few years—especially if he goes with another firm.

Formal Training

In order for a man to make a success in the field of machine design, and to progress from there to positions of responsibility in guiding design, he should have a thorough training in engineering fundamentals. He should be reasonably familiar with mathematics, including differential equations, physics, chemistry, mechanics, strength of materials, the theory of structures, and the other fundamental courses given in most accredited mechanical-engineering curricula; and he should know the fundamentals of electrical engineering. In the field of machine design there are many other specialties, and it would be desirable for the engineer to have at least a smattering of some of those special skills. Among those special skills might be listed metallurgy, motion-time analysis, testing techniques, gear design, cam design, hydraulics, vibrations, and stress analysis.

Machine design covers a very wide field and should include

tool design, since many men have to switch from one to the other in some shops. Tool design, on the whole, does not require the ingenuity of machine design, and, after some experience, it becomes relatively routine. But it does demand a good knowledge of shop practices and skill in devising the cheapest method of making the tools. In machine design a large range of products used by engineers can be covered. It is fairly common to include in "design," articles which are not really machines. This may be stretching the point; nevertheless, the skill and experience necessary to design such objects may be great. For example, machine designers design kitchen sinks, gas ranges, and refrigerator boxes, although these are really not machines.

WHAT DOES INDUSTRY EXPECT OF THE GRADUATE ENGINEER?

What is expected of a young graduate when he goes into industry directly from college? You will hear complaints all the time from industrial representatives that college graduates are not trained in design, and they are not competent draftsmen when they go into industry. This, of course, is generally true; but, frankly, such criticisms may be ignored. The college cannot train the student to do everything, and there is a very distinct question whether a technical college should train a student in the development of manipulative skills. Because of the limited time available in colleges, they can, at the moment, only attempt to make the student fully cognizant of the fundamentals in engineering. The development of any specialized skills should either be put off until the graduate year or should be acquired in industry. Thus perhaps, on the average, the industrial representatives do not expect the graduate engineer to be a skilled draftsman or designer; but they do expect him to know the fundamentals of engineering, and they do expect that, because of this greater knowledge he should be in a better position to become a machine designer in relatively quick order than one without this college training.

The training to become a machine designer is not easy. The man has to think about his job, has to be observant, and must have an inventive type of mind. If the student is not creative, there is little real opportunity for him in the field of design; without creative ability he might eventually develop into a pencil pusher. On the other hand, without creative ability, an engineer, generally, won't get very far in any field.

HOW DOES HE PROGRESS?

What would the young graduate have to do to prepare himself for promotion in the field of machine design? Probably, at the very beginning, he would be put on a board and would work as a detailer, taking the designs prepared by a competent designer and preparing the details for production. This is a very necessary training for a designer. No man should really classify himself as a designer who doesn't know how to make the individual parts in the shop. Also, in conjunction with this detailing experience, or before, or after it, the student should take a course in the shop, in order to acquire at least a superficial knowledge of how the various machines operate and how parts are made. This gives him a clearer picture when he starts to make details, and, if undecided how to make a particular part, his machine-shop training would stand him in good stead.

After getting this machine-shop and detailing experience, it would be expected, if he shows promise, that he would be put on layout work and then on the designing of small parts, and eventually on more complicated machines. Before a man can become a designer he should not only have the ability to create new designs but also have the capacity to think in three dimensions, since if there are moving parts in a compact machine, the designer must be able to visualize in his own mind how these parts are going to behave relative to one another, and whether, for example, there might be interferences. It is much cheaper to eliminate interferences on the drawing board than in metal.

Engineering is not a static profession. New materials and new designs are being developed constantly. Thus it would be expected that a young graduate should try to keep up with the world after he has graduated and not assume that he has acquired all his education. For example, in the design of parts of a machine, a new development might indicate that a certain plastic material would be better suited than steel. Unless the young man was aware that the new plastic existed, he would be in no position to determine whether it should be used. Perhaps the easiest way for the young engineer to keep abreast of new developments is to maintain an active membership in a technical society. The mechanical engineer, for example, could maintain membership in The American Society of Mechanical Engineers and should read the technical articles which might be of use to him in his daily work. This, of course, is not enough. Many things are developed which are not published. Sometimes a man can get considerable help by talking things over with other workers in the same general field. This, generally, means that the man has to acquire acquaintanceship with several engineers, at least in his neighborhood. Perhaps the easiest way to do that would be for the student to take part in the activities of a local ASME group.

In order to take part in activities either of the national or local branches of the Society, the graduate should not become merely a listener. He should participate. This means that he should acquire the ability to write and to speak effectively. Unfortunately, in the past, engineers have paid too little attention to the ability to speak in public, and this has been reflected in salary scales. For many years, however, it has been apparent that engineers have been paying more attention to it, and this has shown up in the promotions made by men in the engineering field. The following figures might be of interest.[1]

"A statistical table covering a variety of industries, consulting engineers, and colleges indicates that while only 1.9 per cent of the total employment are college graduates, the percentage occupying positions from department heads to chairmen of the board amounts to 28 per cent.

"In the field of machinery, out of a total employment of 96,184 employees reported for 14 companies, 1836, or 1.9 per cent were engineers with college education.

"Out of a total of 888 in executive capacity, ranging from department heads to chairmen of the board, 393 were engineers, or 44 per cent."

Note that there were 888 executives, and 393 of them engineers, out of a total of 1836 engineers. Thus about 21 per cent of all the engineers were executives as against 1.9 per cent for everyone.

These last figures are for the machinery fields, but the same thing is true in most other industries, although perhaps in modified form. The percentage of engineers who have come up through the ranks of designing to reach positions of prominence is increasing steadily. The only trouble is that there are so few such men that generally a choice cannot be made, and thus the opportunities for the young man with college training, creative ability, and some shop experience are very great.

It has been fairly common practice in the past to appoint the senior executives in an organization from the business staff, since, primarily, the problems are those of a businessman. Any executive today should know something about business too,

(*Continued on page 976*)

[1] "Employer Practices With Respect to Engineering Graduates," *The American Engineer*, vol. 18, January, 1948, p. 18.

FURNACE BRAZING *of* MACHINE PARTS

Part 2—Fixtures, Joint Types, Fits, Metals and Their Properties, and Typical Furnaces Used in Brazing

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COMPONENT parts of assemblies to be brazed must be held in their proper relationship in the trip through the brazing furnace. To this end, gravity can be one's best friend or his worst enemy, because it may help hold parts together or it may cause them to try to move with respect to one another, after they heat up and expand. Gravity may also affect the flow of brazing metal into or away from the joints.

SELF-LOCKING VERSUS FIXTURING

It is important that the assemblies be so fashioned that they will self-lock themselves or be provided with auxiliary fixtures for the purpose. This factor should be given thought at the inception of the idea for furnace brazing, as should the matter of best locating the brazing metal, and the type of joint most likely to give the results desired.

Perhaps the simplest method of assuring proper relationship between parts is to just lay one on top of the other. However, this method sometimes lacks the advantage of indexing. An example is the refrigeration evaporator plate, Fig. 29, which, in preparation for furnace brazing, consists of a flat plate on top of which is laid a sheet of copper foil, 0.002–0.005 in. thick, for brazing metal, then an embossed plate, and some auxiliary weights to press the plates together as they travel through the furnace, to assure intimate contact and tightness of the bonds. Such assemblies are often spot-welded in the center for indexing.

Perhaps the most common type of joint encountered in furnace brazing is the sleeve fit, illustrated in Fig. 30, in which a flange is shown on a shaft. With a vertical axis as illustrated, expansion upon heating might result in movement of the flange, and several methods are utilized to prevent this, such as staking, as indicated in Fig. 30 in exaggerated fashion, tack welding, pinning, or a shoulder. With a horizontal axis, however, movement is not so common and such precautions are usually unnecessary. An advantage of the sleeve fit is that the area can often be controlled to the extent that the ultimate strength of the bond is equal to or greater than that of one or more of the components.

When spuds are inserted in shells, it is best to avoid the construction as shown in Fig. 31(A), where the tenon is simply pressed into the hole. It is possible, upon heating and expanding, for the spud to tilt or drop out completely. The methods shown at the right in B, C, and D are much superior. At B, the tenon is long enough to be staked to lock the hub in place. If the shell is of adequate thickness, another method C is to stake the shell around the hole to lock the hub in place. But perhaps the best method of all is the one shown at D, in which the extended tenon is spun or swaged. This gives positive uniform results, which can be depended upon for uniform strength and tightness when the brazing metal creeps throughout the entire joint and appears on the opposite side. The spud can either be countersunk or counterbored to make its wall thin for the spinning or swaging operation. The hole in the shell needs only to be punched, without drilling or reaming. The loose fit of the parts will be tightened during the

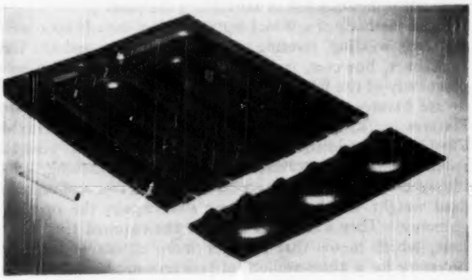
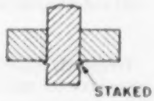


FIG. 29 STEEL REFRIGERATION EVAPORATOR PLATE

FIG. 30 (*right*) SLEEVE-FITTED PART



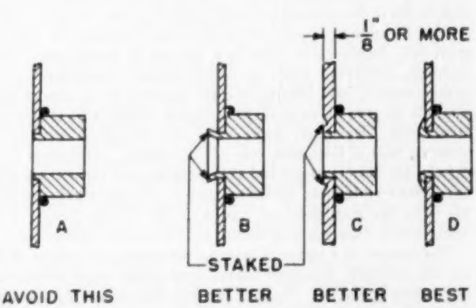


FIG. 31 METHOD OF INSERTING SPUD INTO A SHELL

NOTE: Part 1 of this paper appears on pages 863–869 of the November issue of MECHANICAL ENGINEERING.

Contributed by the Machine Design Division and presented at the Annual Meeting, New York, N. Y., November 26–December 1, 1950, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

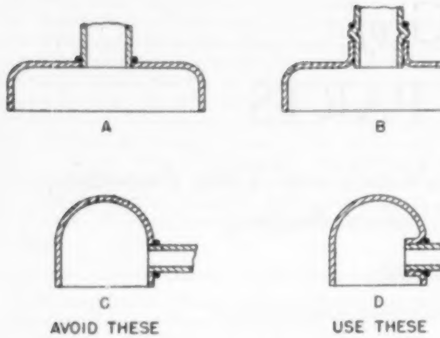


FIG. 32 PUNCHED HOLES VERSUS EXTRUDED HOLES

spinning or swaging operation, thus giving ideal conditions for furnace brazing, at low cost.

The use of extruded holes in stampings where tubular members are to be inserted is highly desirable. Fig. 32 cites the advantages of this construction. For example, the punched holes at A and C, in Fig. 32, should be avoided, if possible, and preference be given to the extruded holes B and D. The latter not only give greater bonding area for high strength and tightness, but sometimes aid in assembling the parts.

Other methods of self-locking assemblies include spot welding, tack welding, riveting, pinning, crimping, and the like. Sometimes, however, it is not possible to successfully incorporate any of the foregoing methods, and it is found necessary to use fixtures to maintain proper relationship of the parts. Fixtures are avoided wherever possible, for several reasons. They not only introduce an investment cost, but generally require considerable maintenance such as straightening, grinding, or machining. They are often fairly heavy, and represent dead weight which absorbs heat and impairs the operating economy. They sometimes increase the required time in the heat, which means that a larger more expensive furnace is necessary for a given amount of production. In spite of these disadvantages, however, fixtures are sometimes utilized in furnace-brazing production, with the process still being practical and economical.

FITS AND CLEARANCES

Frequently questions are asked regarding the fits and clearances between parts to be assembled for furnace brazing. Is it necessary to allow a gap in the joint to permit capillary attraction to draw the brazing metal through the joint, or can better results be obtained with metal-to-metal contact, or even a press fit? Inasmuch as there is a variety of conditions to be satisfied, involving types of parent metals, combinations of parent metals, and brazing metals utilized, it is almost impossible to give an over-all prescription which will satisfy all conditions. However, some rules can be given which, in general, will at least keep one out of trouble. Optimum conditions for best strength and tightness are not always adhered to, however, because wider tolerances are sometimes acceptable from the standpoint of results, with the machining cost being lower than when optimum conditions are strived for.

The results of a series of tests to determine the effects of fit on the strength of copper-brazed low-carbon steel assemblies are shown in Fig. 33. Each of the four bars shows the average, minimum, and maximum strength of ten test samples of the pull-out type, made from small rods and disks, with the area of the joint carefully measured so that the strength could be plotted in lb per sq in. shear. The bottom bar shows results with 0.003 in. gap in the joint, but only six of the ten samples were used in plotting the data because the other four had voids in the joints and were not considered representative. This fact alone indicates the undesirability of having gaps of appreciable size in such assemblies. The adjoining bar, for metal-to-metal fit, indicates marked increase in strength. The upper two bars, with light and heavy press fits, show little if any further increase in strength, but at the same time no adverse effects.

From these results and similar experiences, it is generally considered advisable in copper-brazing low-carbon steel to avoid loose fits and to adjust the tolerances for metal-to-metal

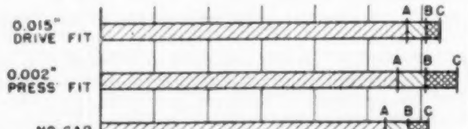


FIG. 33 EFFECT OF TIGHTNESS OF FIT ON STRENGTH OF COPPER-BRAZED JOINTS (LOW-CARBON STEEL)

fit ranging into press fits. In view of the foregoing, and from experiences with other metals under a variety of conditions, the following guide is offered:

1 Brazing low-carbon steel with copper—size to size to light press fit.

2 Brazing high-carbon steel with copper—0.001 in. loose on diameter to light press fit.

3 Brazing nonferrous or ferrous metals with silver alloys—0.002–0.004 in. loose on diameter.

4 Brazing aluminum alloys with aluminum-silicon alloys—0.012–0.050 in. loose on diameter.

PARENT METALS

A wide variety of parent metals and combinations of parent metals can be successfully furnace-brazed when proper technique is employed. Many of these can be easily brazed, some present slight difficulties, and others serious difficulties which often can be overcome. There are some, of course, which cannot be handled in this manner at all. The assortment of usable ones, however, is such that electric-furnace brazing enjoys rather wide application. Parent metals commonly furnace-brazed include practically all AISI standard steels, stainless and other high-alloyed steels, cast iron, copper, nickel, copper-nickel alloys, copper alloys such as brass and bronze, sterling silver, nickel silver, a few of the aluminum alloys, including 2S, 3S, 53S, and 61S, and a magnesium alloy, namely, Dowmetal M (9).[1]

CLEANLINESS

Related to the parent metals is the question of cleanliness. Must grease or oil be removed from the parts prior to assembling for furnace brazing, or can these lubricants be left on? It is

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

common to remove grease, heavy oils, and soapy lubricants. Lubricants containing lead must be removed, as well as those containing sulphur, because of adverse effects on the strength of the bonds. Some lubricants carbonize within the joints upon heating up, and inasmuch as carbon and the brazing metals have no affinity for one another, the carbon impairs strength and tightness of the bonds. Nevertheless, light oils are sometimes left on the parts, particularly for automotive and similar work, where tightness is not a factor and satisfactory results are still obtained. A degreasing operation is sometimes utilized to remove the lubricants, but residues are often left on the parts. A good high-temperature caustic wash with steam rinse often does an effective cleaning job in removing all foreign material from the parts. The need of a good rinse after the caustic wash is emphasized, however, because it would probably be better to leave light oil on the parts than caustic, from the standpoint of obtaining good bonds.

BRAZING METALS

There is also a wide assortment of brazing metals (10, 11) which are successfully utilized in furnace-brazing work. The bulk of the furnace-brazing applications, however, narrow down to a few commonly used brazing metals, as follows:

1 Copper is used for perhaps 95 per cent of the furnace-brazing output for two reasons. Most of the furnace-brazing jobs are on low-carbon steel, on which copper wets excellently and creeps into joints without the aid of an auxiliary flux. The avoidance of flux, which requires application and subsequent removal, is copper's most important advantage, since most other brazing metals require flux. Its low cost is another factor. Some parent metals require flux even with copper as the brazing metal, if certain alloying elements exceed about 2 per cent total, such as chromium, manganese, silicon, vanadium, and aluminum. However, these alloying elements seldom exceed 2 per cent in the standard steels, and fluxing is generally not necessary for copper.

2 Brass is often suggested as a brazing metal because of its low melting point, but is seldom used. Sometimes it is employed on parent metals which cannot withstand the high temperature required for copper. Zinc distills from the brass, however, which entails three important disadvantages. First, zinc loss results in increased melting point of the brass. The increasing melting point requires that the furnace be operated at 1850 to 1950 F to assure melting of the brass, in which case the temperature might as well be increased another hundred degrees or so to 2050 F, to allow the use of copper, if the parent metal can withstand the extra temperature. Second, zinc attacks heat-resisting alloy parts in furnaces. Third, the zinc oxidizes on the surfaces of the brass even in the protective atmospheres, forming a retaining shell which holds the molten brass within it. This means that a solvent flux must be utilized to assure flowing and wetting, which is accompanied by the expense of its application and subsequent removal.

3 Several phosphorus-copper brazing alloys, some of which also contain silver, are available for use on nonferrous parent metals, which flow at temperatures of 1300 to 1400 F. These brazing metals, because of their phosphorus content, are self-fluxing on copper but usually require auxiliary fluxes when used on brass and other zinc-containing alloys. They are not suitable on ferrous metals because the iron phosphide formed is weak and brittle. Typical proprietary names of such brazing alloys are Sil-Fos,[2] Silvaloy 15,[3] Phosco,[4] and Phos-Copper.[5]

4 Low-melting silver-brazing alloys are available, containing silver, copper, cadmium, and zinc, which are excellent on both ferrous and nonferrous parent metals, flowing at 1175 and 1145 F. Fluxes are practically always required with them. Typical proprietary names are: Easy-Flo,[2] Silvaloy 50,[3] and Sil-Ex[4] (1175 F); Easy-Flo 45,[2] Silvaloy 45,[3] and Sil-Bond[4] (1145 F).

5 Several aluminum-alloy brazing metals (5, 6, 7, 8) have been developed by the Aluminum Company of America, with designation numbers and brazing ranges as follows:

Number	Composition	Brazing range—deg F
711	Aluminum, silicon, zinc	1160–1185
713	Aluminum, silicon	1100–1135
718	Aluminum, silicon	1070–1080

FLUXES

Where fluxes are needed (10, 11), it is important that they melt at a temperature below the melting point of the brazing metal, to assure effectiveness. An assortment of fluxes is available from welding and brazing supply houses, and recommendations can be obtained from them, or from suppliers of brazing metals.

FORM AND LOCATION OF BRAZING METALS

Brazing metals are of course available in various forms, such as wire, foil, and powder. They are sometimes sprayed on parts with an oxyacetylene gun or electroplated. Location of the brazing metal is an important factor; it is sometimes placed at the joints, above the joints, or even within the joints. A few suggestions for locating the brazing metal will be given.

Wire is used in rings, straight lengths, slugs, and hairpins. Sometimes a large ring lying on a flange at the joint of an assembly, as shown in Fig. 34(A), will warp and open up. Upon melting, it may run away from the joint or puddle on the flange. To avoid this, the ring is sometimes placed above the joint, made of hard wire and formed slightly undersize to help

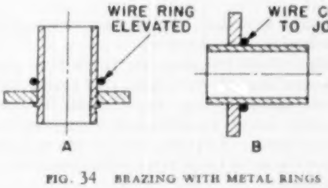


FIG. 34 BRAZING WITH METAL RINGS

hold it in place. Upon melting, the brazing metal runs down the side and is drawn into the joint by capillary attraction. Even if it should warp a bit, it will probably tilt and hang in place to give the same desirable result. This suggestion for assemblies with vertical axes does not apply for assemblies with horizontal axes, however. In such cases, as at B, care should be taken to have the wire ring placed snugly against the flange so that it will be drawn into the joint upon melting. Even then, large-diameter rings, say, 2 in. diam or more, have a tendency to warp and flow away from the joint. In such instances, half-rings of larger-size wire, placed on the top side of the joint, generally overcome the difficulty and work successfully.

A highly recommended method for locating rings is to embed them in grooves cut in parts as they are being machined, as illustrated in Fig. 35. So locked, the rings cannot warp and get away. The brazing metal has no alternative but to creep

[2] Handy and Harman.
[3] American Platinum Works.
[4] United Wire and Supply Corporation.
[5] Westinghouse Electric Corporation.

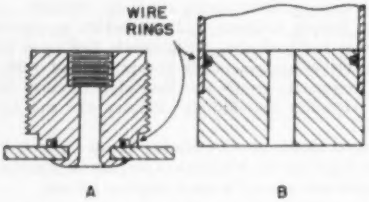


FIG. 35 BRAZING WITH EMBEDDED WIRE RINGS

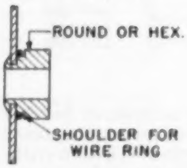


FIG. 36 SHOULDER ON SPUD LOCKS RING IN PLACE

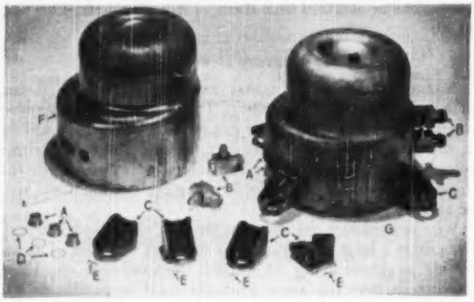


FIG. 37 COPPER-WIRE SLUGS *E* ARE USED FOR BONDING BRACKETS TO A REFRIGERATOR SHELL

through the joints as desired, showing up at extremities to give visual indication of good bonds.

A modification of the foregoing suggestion is to provide a shoulder on a spud, Fig. 36, to lock the ring against the shell. In addition, the method is especially desirable for hexagonal fittings. Hexagonal rings are difficult to form, keep in shape, and to apply on parts. A round shoulder cut on hexagonal stock facilitates the use of round rings, which are easy to form, handle, and apply.

Wire is cut in short lengths and used as slugs in numerous cases. In Fig. 37 such slugs are shown at E, and are used for bonding the brackets which have been projection-welded to the shell for extra strength, the assembly shown being a dome for a hermetically sealed refrigerator. When the brackets are stamped, they are formed with lips at the top to provide recesses for the slugs. The slugs are shown in place in Fig. 38 (see arrows). They are positioned easily and inexpensively by the operator, and the recesses form good reservoirs for the molten brazing metal. Another feature shown in Fig. 38 is the spuds in the shell, which are provided with shoulders on which copper-wire rings have been placed, in the fashion indicated in Fig. 36.

Foil is used as brazing metal in the form of wide strip, Fig. 29, narrow strip, Fig. 39, clips, etc. Thus, as discussed along with Fig. 29, copper foil is commonly used between two steel sheets for brazing flat evaporator plates. In Fig. 39, which illustrates a header for a steel-fin condenser for refrigerators, during assembly (left) and after crimping (right), a piece of copper strip serves as a convenient and positive means of locating the brazing metal between the two stampings.

Brazing metals in the form of powder are commonly utilized, sometimes dry, but usually mixed with a liquid vehicle, such as clear lacquer and thinner, or propylene glycol. This "paste" is most commonly daubed on with a brush, but is sometimes sprayed on or the parts are dipped in it. An advantage of this form of brazing metal is that it can be applied to irregularly shaped joints to which it is difficult to apply brazing metal in any other form. 150-mesh copper powder is commonly used with lacquer, while 500-mesh powder is commonly used with propylene glycol.

The lacquer hardens and is sometimes preferred for that property. In Fig. 40 it helps lock copper-wire rings at the joints so they won't move away in handling around the shop prior to brazing. It also starts the wetting action to help draw the copper from the rings into the joints, as well as serving as a supply of brazing metal in itself. The propylene glycol does not harden like lacquer, and is occasionally preferred for that property, as well as the fact that it keeps the copper in suspension better than lacquer, and does not tend to gel. The lacquer paste stays in place when the assembly strikes the heat, but the propylene-glycol paste has a tendency to run as soon as it gets warm, sometimes allowing brazing metal to drip off vertical surfaces or parts before it melts. Commercially mixed pastes are also available (16), a typical proprietary name being Cubond.[6]

Any brazing metal which can be formed into wire can be melted and sprayed from an oxyacetylene gun. An example in which brazing metal has been applied in this manner is the hollow steel airplane-propeller blade shown in section in Figs. 41 and 42. Three long seams between the forging and sheet-metal member are copper-brazed. Prior to assembly, surfaces near the edges and along the center are grit-blasted and then

[6] Metals Refining Co.

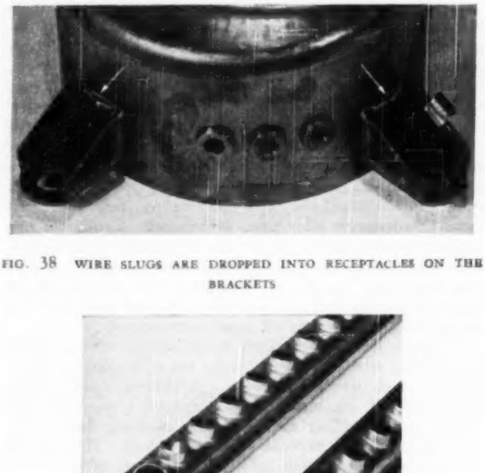


FIG. 38 WIRE SLUGS ARE DROPPED INTO RECEPTACLES ON THE BRACKETS

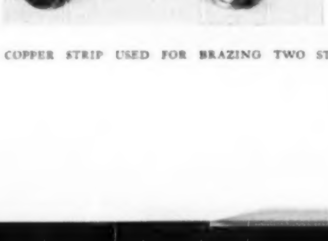


FIG. 39 COPPER STRIP USED FOR BRAZING TWO STAMPINGS

sprayed with copper to supply the brazing metal which, after assembly, is within the joints. This method has been found better than any other for this particular product.

Electroplating is often suggested and sometimes used successfully for applying brazing metals to assemblies. An example of this is shown in Fig. 43 which is a telephone switchboard bracket. Copper-plating of the three small pins in the left-hand view eliminates the use of tiny copper-wire rings, which are difficult to handle. After brazing (right), copper is seen on the body members near the joints, indicating that bonds have been obtained. Electroplating must be used cautiously because it introduces a sandwich of brazing metal within the joint, while instead, it is commonly preferred, when copper-brazing low-carbon steels, to have intimate steel-to-steel contact and require the brazing metal to flow in by capillary attraction. Also, when copper melts within the joints, it may run out and leave voids, impairing the strength and tightness, unless an external surplus is available to make up for this. Then, too, electroplating usually varies widely in thickness, and thus in its amount. Nevertheless, there are numerous cases in which this method is used to good advantage in electric-furnace brazing.

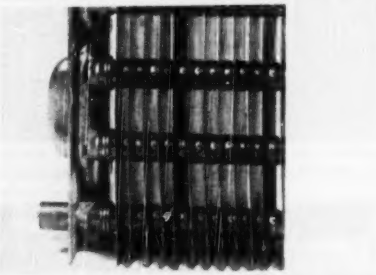


FIG. 40 POWDERED BRAZING METAL MIXED WITH A LIQUID VEHICLE WAS USED ON THIS STEEL-FIN CONDENSER

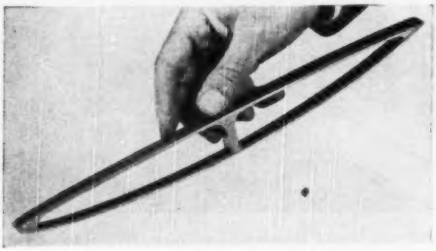


FIG. 41 FURNACE-BRAZED STEEL PROPELLER BLADE

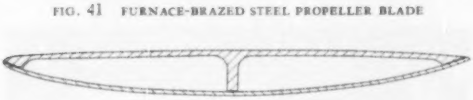


FIG. 42 THREE LONG SEAMS ARE COPPER-BRAZED

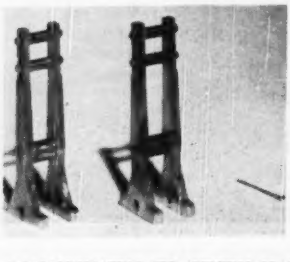


FIG. 43 USING ELECTROPLATING FOR APPLYING BRAZING METALS

PHYSICAL PROPERTIES

Most metals, unless they are of the air-hardening type, come from the brazing furnace uniformly dead-annealed. This condition is generally considered highly desirable, but occasionally the loss of cold-worked hardness in the parts is detrimental to the job. Sometimes this makes it necessary to abandon a furnace-brazing project and use a local means of heating, such as torch brazing or induction brazing. There are some ways to overcome the difficulty, however, and these are as follows:

1 Cold working of parts after furnace brazing will give just as good hardness and stiffness as though the cold working were done before brazing and the parts did not go through the furnace. The pulley, Fig. 7, Part 1, is an example.

2 Cyanide hardening of low-carbon steel assemblies after furnace brazing stiffens them somewhat. This method is used in the fabrication of automotive and tractor rocker arms and other such parts.

3 If the parent metal contains sufficient carbon to be heat-treatable, heat-treating after furnace brazing will of course improve the physical properties. It appears, in fact, that the same properties can be obtained by heat-treatment after furnace brazing as can be obtained by heat-treating as-received stock. A large number of furnace-brazed assemblies are heat-treated after brazing, with satisfactory results.

Air-hardening steels harden upon quick transfer from the heating chamber to the cooling chamber in a copper-brazing furnace, and emerge from the cooling chamber in normalized condition, with high strength in the parent metal.

The strength of copper-brazed bonds after heat-treatment is, in general, satisfactory if the assemblies are fairly uniform in section so that quench stresses are not set up in the bonds. Although the results of some work have been published (1, 2, 3, 4, 12, 13) there is still room for considerably more work in this direction. Good strength has been obtained in heat-treated low-carbon carburized assemblies (1), as well as in medium-carbon ones (1, 12, 13). The apparent unit strength within a bond has been demonstrated to be considerably affected by the type of test specimen utilized (13). Best data for a given job are determined by building actual samples of the product and testing them to destruction.

FURNACE-BRAZING EQUIPMENT

Various types of brazing furnaces and protective-atmosphere-producing equipments are used in this work. The most common types of furnaces are the box, mesh-belt, and roller-hearth-conveyer types, but other types are occasionally used. A typical setup consists of a furnace with cooling chamber attached, transformers if needed to give proper voltage on the electric heating units, power control panels, temperature control instruments, and a suitable atmosphere-gas-producing unit.

A typical box furnace is shown in Figs. 44 and 45. It has a heating chamber and water-jacketed cooling chamber attached, with three doors. The two end doors are normally closed to keep the gas in, and the refractory center door is normally closed to keep the heat in, thus assuring longer working length and better operating economy, than if it were

not there. The box furnace with cooling chamber is the most flexible-type furnace built. It is good not only for furnace brazing but for bright annealing, bright normalizing, scale-free hardening, and sintering. For most of these operations, the trayload of work is pushed into the heating chamber, where it rests on hearth rails until the work is heated through. Then it is subsequently pushed into the cooling chamber, and moved intermittently along, finally being pulled out the discharge door. For hardening, hinged-bottom trays are employed. The trayload of hot work is pushed out over the quench chute, the bottom drops, and the work falls through the quench chute into oil, being caught by a basket which is then moved sideways, pulled out, and the work is dumped into tote boxes. The tray is pulled out the discharge door. The box furnace is best suited for small rates of production or experimental work. Sometimes two or three of them are mounted side by side, as production requirements increase. This type of furnace is practical and economical to operate on light, medium, or heavy-weight parts.

The mesh-belt-conveyer type furnace, Figs. 46, 47, and 48, is built similarly to the box type, with heating chamber and cooling chamber attached. It differs in that it has a continuously traveling wire-mesh belt, which slowly carries work through the furnace. In this type, all doors throughout the furnace are normally open to clear the work; thus the gas consumption is higher than in the box type, in order to maintain suitable purity of protective atmosphere within the furnace. Because the hottest section of the belt is relatively weak, this type of furnace is limited to handling light and medium-weight parts, in order to obtain reasonable belt life. Operators load work on the belt at the charging end of the furnace, and either lift it off at the discharge end or allow it to dump into tote boxes. The mesh-belt furnace is utilized for larger rates of production than the box furnace. It appeals to manufacturers because of its continuous feature, which gives constant movement and timing of the work, with no handling of trays.

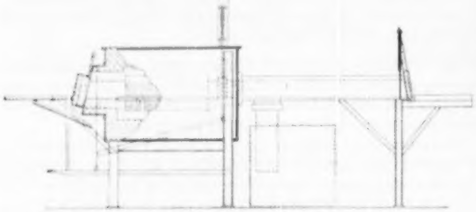


FIG. 44 LONGITUDINAL SKETCH OF TYPICAL BOX-TYPE BRAZING FURNACE

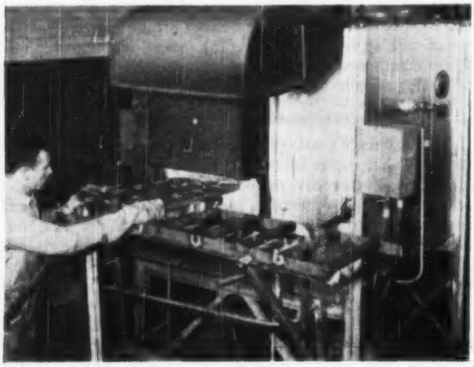


FIG. 45 STEEL PULLEYS READY FOR BRAZING, ARE PUSHED INTO HEATING CHAMBER OF BOX-TYPE FURNACE

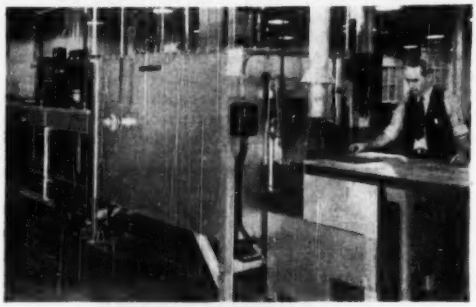


FIG. 46 MESH-BELT-CONVEYER TYPE BRAZING FURNACE

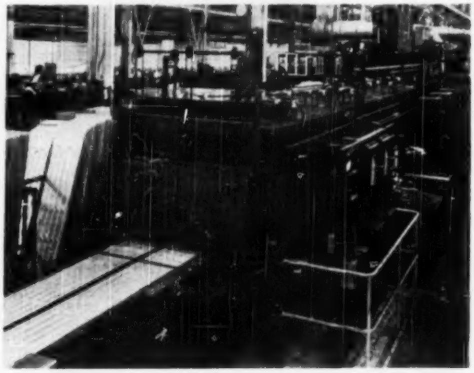


FIG. 47 ALUMINUM EVAPORATOR PLATES ENTER CHARGING END OF MESH-BELT-CONVEYER TYPE BRAZING FURNACE

FIG. 48 AUTOMOTIVE TRANSMISSION SUBASSEMBLIES EMERGING FROM COOLING CHAMBER OF MESH-BELT FURNACE

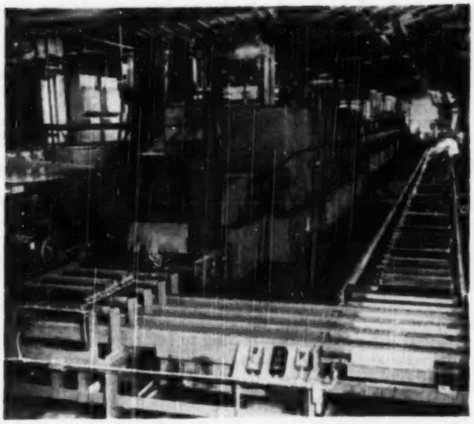


FIG. 49 STEEL-FIN REFRIGERATOR CONDENSERS BEING FURNACE-BRAZED IN ROLLER-HEARTH-CONVEYER TYPE FURNACE WITH RETURN CONVEYER AND TRANSFER TABLES

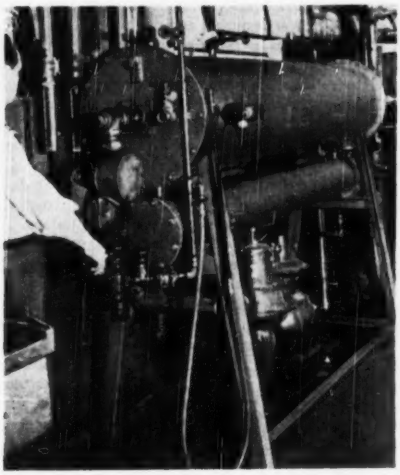


FIG. 50 EXOTHERMIC-TYPE ATMOSPHERE GAS PRODUCER

The roller-hearth-conveyer type brazing furnace, Fig. 49, has a driven roll table throughout its length, on which tray loads of work are carried through continuously. The end doors are normally closed, but the throat doors are adjusted open to clear the work. This type of furnace is best suited for high rates of production, such as on automotive and refrigeration work. It is practical and economical to operate on light, medium, and heavy-weight parts. The rolls turn continuously, thus redistributing their stresses and staying straight. They can carry relatively heavy loads and still have long life. The trays are simply rolled through without pushing and pulling stresses, and they, too, have long life. The maintenance cost per pound of work is, therefore, lowest in this type furnace.

Most roller-hearth furnaces have automatic charging and discharging of the trays, and many of them are equipped with a return conveyer, as shown in Fig. 49, with transfer tables to carry the trays from the furnace line to the conveyer line, and vice versa. The trays go around the circuit automatically, the only labor required being that for removing brazed assemblies and loading prepared ones. Thus the roller-hearth-type furnace is the most economical type to operate, from all standpoints—personnel, economy, and maintenance—per pound brazed.

Although hydrogen and its lower-cost substitute, dissociated ammonia, are excellent gases for furnace brazing, one of the most important reasons for the widespread success of the process is the development of gas producers which reform hydrocarbon gases into suitable low-cost protective atmospheres. Partially combusted fuel gas, such as coke-oven gas, natural gas, or propane, formed in an exothermic gas producer such as that shown in Fig. 50, is moderately reducing and very low in cost. It is utilized for most of the furnace-brazing applications,

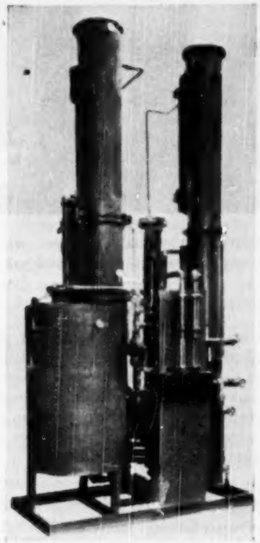


FIG 51 EXOTHERMIC-TYPE PRODUCER FOR MAKING CO_2-FREE DRY NONDECARBURIZING ATMOSPHERE GAS

particularly on low-carbon steels which constitute the bulk of the work. The gas consists of about 15 per cent hydrogen, 10 per cent carbon monoxide, 5 per cent carbon dioxide, 1.5 per cent methane, and 3 per cent water vapor, the remainder and largest portion being nitrogen. This gas gives good wetting action and good bonding, producing bright work on low-carbon steel. It will, however, decarburize medium or high-carbon steels, leaving a soft skin after heat-treatment, which may have to be ground or machined off afterward. For such applications, other protective atmospheres are available which will not decarburize during the furnace-brazing treatment, and if the parts are hardened in the same atmosphere, they will have hard surfaces. Typical gas producers of this type are shown in Fig. 51 which illustrates an exothermic-type producer for making CO_2-free, dry, combusted gas, and Fig. 52, an endothermic-type producer, which provides a catalytically reacted hydrocarbon gas, both of which have the nondecarburizing property.

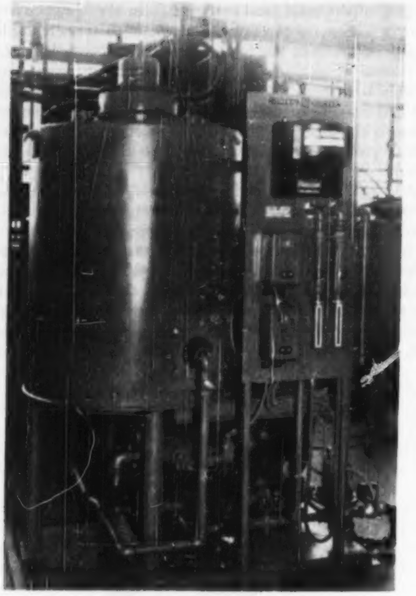


FIG. 52 ENDOTHERMIC-TYPE GAS PRODUCER FOR MAKING NON-DECARBURIZING ATMOSPHERE GAS

CONCLUSION

The furnace-brazing process is a modern production tool which has taken its place among established fabricating methods, and is constantly expanding its sphere. Although it was felt ten years ago that reasonable progress had been made in the development and usage of the process, it is now found that there is over four times the productive brazing-furnace capacity in use as there was at that time.

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Machine Design as a Career

(*Continued from page 968*)

and thus if a designer is expecting to be promoted eventually to a position of responsibility, he should not ignore the business aspects of engineering. He should know, for example, how to read a balance sheet, how to prepare a budget, how to prepare intelligible reports to be read by businessmen, and how to defend engineering practices in discussions with nonengineers.

OPPORTUNITIES IN FIELD OF DESIGN

The opportunities for a good machine designer with engineering training are excellent. For example, in one large engineering research and development department there are in the neighborhood of 250 designers and draftsmen. Of those, only about four are graduate engineers still on the board, and they are among the outstanding men in the organization. But those men are basically individualists and not department-head material, although in each case they were put in charge of a section as a tryout. It didn't work out too well, and they are back as designers, largely because administrative matters were of less interest to them than was the design work. Clearly, then, if a few engineering graduates were to take up designing in that organization they would have a wonderful opportunity. This is fairly typical in the machinery industry today.

A well-trained machine designer is not restricted to the field in which he works. For example, at the beginning of the last war the United Shoe Machinery Corporation Research Division, which has a splendid group of machine designers, began to help out by designing equipment for the armed services. This included such items as gun mounts, gun turrets, fire-control equipment, gun directors, fuse cutters, automatic guns of several sizes, and so on. In spite of the newness of the designs, they found such matters rather easy compared with shoe machinery, and they made an outstanding record with the armed services.

Other concerns had similar experiences.

One such machine designer, in a not too great number of years, worked on such varied items as automobile engines, fans, blowers, automatic machinery, tool design, sewing machines, automobile bodies, hydraulic presses, candymaking machines, heat-transfer and air-conditioning equipment, streamlined trains, special electric motors, hydraulic dynamometers, shoe machinery, gun turrets, and general fire-control equipment. The ability to switch from one field to another without serious inconvenience gives a man a great deal of self-confidence.

SUMMARY

In summary, then, in the author's opinion, the field of machine design is very interesting, and there is a big opportunity in it for college-trained engineers who have creative ability. If to that can be added the ability to guide men, the prospects are attractive indeed.

Building SAFETY *Into* TEXTILE MACHINES

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AN accident is an event involving the "contact" of a person with an object, a substance, or another person, the "exposure" of a person to objects, substances, or other persons or conditions, or the "movement" of a person, which causes personal injury or suggests the probability of such an injury. Leading up to the event in nearly every instance is some motivation on the part of an individual combined with faulty judgment of intervals in space or in time. Thus accident prevention is always closely associated with the human equation. Recognition of this fact has led safety-engineering authorities to consider increasingly the personal factor and to carry through design with more in mind than the simple provision of guards of one type or another. We have left the bird-cage era in which the worker was to be protected against himself in spite of himself, and have progressed into the fields of aptitude testing, proper placement, and education. Along with this, however, emphasis continues to be placed on sound engineering practice.

In the matter of physical contacts much has been accomplished. Handling of materials by employees is being minimized by the use of better and more mechanized equipment. Here conveyers, both mechanically operated and of the gravity type, are being used. A significant advance is also evident in the increased use of range or sequence operation where materials can be carried through a number of stages of processing without requiring contact by workers. Outstanding examples are to be found in continuous peroxide bleaching and indigo and Vat Craft dyeing. In addition, increasing success is being achieved in the elimination of operations and in combining operations. Noteworthy examples are to be found in cotton-roving processing and in single-processing picking. The usual safeguards for gears, beaters, and belts are to be found—but dependence for safe operation is no longer confined to these things alone.

Where movement is concerned, protection against accidents falls naturally into two classes; motion of persons, and motion of machinery or things. Continued education in the matter of lifting, prevention of strains, unsafe position and posture, coupled with engineering design which makes for safe and convenient location of control levers, and starting buttons or switches continues. Increasingly machines are being designed to minimize the need for operators to move about unduly in carrying on their work. A good example is the modern spooler which brings the work to the operator, or which automatically performs many of the tasks once required of the worker. The automatic loom also has reduced the number of trips to a given machine on the part of the weaver. It is important here to note what seems to be a fundamental principle, i.e., that when a machine or process is properly engineered for maximum efficiency it also is safer to operate.

Advances in lubrication techniques, as, for example, the "one-shot" method, have minimized in many instances the temptation to perform this function unsafely on moving equipment—and where applied to overhead shafting have reduced greatly the need for climbing and reaching.

Almost 25 per cent of personal injuries affect the fingers, some 20 per cent happen to the body, and 13 per cent to the legs. These are obviously the parts of the body most likely to be injured by movement or contact. Design of equipment in such fashion as to reduce the frequency of such injuries deserves the attention of every machine builder. In this connection, steps taken to reduce the frequency of necessary adjustments pay dividends. Here the operation of the machine to produce material having a high degree of uniformity is important. Hence quality control is to be considered as a safety measure in addition to its other advantages.

MOST EFFICIENT DESIGNS ALSO SAFEST

Exposure to extremes of temperature—most frequently high temperatures—is often encountered, particularly in drying and finishing machinery. Again, the best design and construction is the most economical and the safest. Adequate insulation at the right places not only conserves heat, but protects the operator against burns as well. Meters which give readings of temperature conditions need not be located in a danger zone, but are best installed—along with the controls—at a distance. An old saying in safety work is that next to presence of mind, absence of body is most desirable. Remote controls and automatic controls for temperature, pressure, tension, and speed are in themselves safeguards against accident and injury. Adequate ventilation is also a matter of good engineering and often obviates the need for respirators or other personal protective equipment. Working conditions are improved and no possible handicap to efficient operation is imposed upon the worker. Another exposure not always realized as a hazard in the past is the flicker produced by overhead pulleys and belts when the lighting is poorly located. This produces mental as well as eye strain, and the modern trend to electric drives on individual machines or ranges has greatly reduced this difficulty.

In the textile industry, as in any other, the worker is surrounded by a physical environment of equipment, miscellaneous objects, and atmosphere which, under unsafe conditions, contribute to high frequency of accidents. In general, unsafe conditions fall into a limited number of categories all of them involving engineering design and construction. Equipment may be inadequately guarded, unguarded, defective, unsafe for present use, or unsafely arranged.

In addition, persons perform unsafe acts by reason of improper attitude, lack of knowledge or skill, bodily defect, or because the safe practice is difficult or impossible, as in an emergency. Such unsafe acts also can be classified as operating without proper clearance, failure to secure or warn, operating at unsafe speeds, using equipment unsafely, using unsafe equipment, unsafe placing, taking an unsafe position or posture, working on moving equipment, failure to use personal protective equipment, and horseplay. Of these, all but the last can be guarded

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[1] Chairman of Safety Council and in charge of the Textile Division, Massachusetts Institute of Technology.

Contributed by the ASME Safety Committee and presented at the Fall Meeting, Worcester, Mass., September 19-21, 1950, of The American Society of Mechanical Engineers.

against, at least in part, by proper engineering to minimize risk—plus proper training.

Operating without proper clearance is frequently prevented by suitable mechanical guards. A simple cover or barrier is often adequate. In any case it should not make the functioning of the operator more difficult than before and it should not present a challenge to the operator "to beat the guard." Fortunately, much of the feeding of material into textile machines is automatic, and creeling can be done either while the machine is inoperative or at a safe distance from moving parts. Fortunate also is the fact that in very few textile machines is material fed individually and at frequent intervals. Remote controls are also advantageous, and, again, textile machines, unlike punch presses, for example, are relatively infrequently stopped and started.

THE MATTER OF SAFEGUARDS—TYPES OF ACCIDENTS

Textile machines are not often changed in speed repeatedly during operation—but modern machines operate at higher and higher speeds which call for more attention to proper safeguards on the part of the designer and builder. Range operation of equipment under automatic control takes care of the matter of speed selection and variation, depending upon such conditions as degree of drying, tension, duration of immersion, or pressure.

There are few hazards worse than a defective safeguard or one which has been rendered inoperative. Under these circumstances the operator relies upon protection which is not there. The safeguard must be reliable, easily maintained, and in so far as possible self-monitoring so that any irregularity, defect, or maladjustment is at once evident. Interlocked guards which prevent the operation of the machine when they are not in position have long been used on textile machinery.

Machine arrangement is a matter of safety engineering. Adequate aisle space, safe access, proper lighting, proper flow of product—all contribute to the safety of personnel. Good housekeeping with a place for everything and everything in its place is a must in any safe plant.

Machines should be designed and built so that the operator need never be off-balance while working at them. Hoppers should be of such height that they take adequate amounts of material to avoid unnecessary handling of stock, but not so high as to require reaching or dangerous leaning with resultant strains and falls. Properly designed platforms or ramps frequently can be used to advantage and should either be built in or strongly advocated when the machine is installed. The starting handle of a cotton card is frequently placed low and to one side of the machine so that it may be operated conveniently with one foot, thus leaving both hands free for starting the web of fibers through the trumpet and calender rolls. When properly placed the operator cannot lean forward as he uses it and thus be in danger of losing his balance and contacting the exposed surface of the rotating doffer. Range operation in bleaching with the J-box has done away with the packing of materials into kiers by "treading it down." The operator need not take a dangerous position. Use of metering and control devices of many kinds has obviated the need for taking samples of hot or chemically reactive liquids for analysis. Liquid-level controls and indicators make it possible for correct conditions to be maintained without taking an unsafe position.

It should seldom be necessary for an employee to require personal protective equipment such as waterproof footwear, respirators, or goggles if a really intelligent and adequate engineering job has been done in the matter of drainage, ventilation, screening, and the like. Of course a moving or erecting crew needs safety shoes, and goggles have their place in a machine shop, but it should be seldom indeed that the textile machine should require personal protective equipment other than ordinary precautions as to hair, jewelry such as bracelets, or proper clothing.

The machine designer should have a sound knowledge of the unsafe conditions and unsafe acts which underlie accidents and injuries and an awareness that nobody can predict which accident may result in serious injury or death. In general 1 out of 330 accidents is a major one, while approximately 29 result in minor injuries. The only wise thing is to try to prevent all 330. Thus some knowledge of the types of accidents that occur is also needed, they include: Fall at same level; fall to a different level; strains; struck by; striking against; caught in, on, or between; immersion; exposure to temperature extremes; electric shock; and inhalation, absorption, and ingestion.

Not only safety of the operative but safety of the plant is a matter for the engineer who designs and builds textile machinery. Magnets are being installed in cleaning equipment to trap scrap metal, thus preventing sparks and fire, as well as damage to subsequent machines. Generation of static and its control or elimination pose problems of design. Stop motions which guard against cone-belt breakage and resultant damage to product, or which prevent damage if the bobbin rail overtravels are common practice on roving frames. Proper fusing of electric circuits in machines or their prime movers and the use of circuit breakers, fume or smoke detectors, fusible links, thermostatic releases, automatic sprinkler heads—as for pickers and the like—are a part of the safe operation of machinery.

SAFETY TRAINING

Training of employees is a matter for management, but much of the safeguarding and improved design of machines makes this training problem easier. The time has long gone by when the overseer of a cardroom could display a crippled hand or arm as a badge of honor or a positive sign of long experience. Crippling injuries are a disgrace. That textile plants can now operate millions of man-hours without a lost-time injury is a tribute to management and to the engineering of the machines and equipment now in use. It is conservatively estimated that an accident actually has involved hidden or indirect costs averaging at least four times the direct cost. Safety pays and pays well. The engineer has a responsibility to build safety into the machines he makes so that they will not injure or destroy the fingers, limbs, and bodies they replace. Management has an equal responsibility to buy and pay for the safety built into each machine. Economy here is false economy in the long run.

CONCLUSION

Management is increasingly aware of the cost of accidents in dollars, in suffering, and in life. It is keeping more complete records, availing itself increasingly of technical information, and making more intelligent analyses of accidents and their causes. The textile press has carried much valuable material in the past few years. So much so that hardly an issue of any of the leading textile magazines in the field of manufacturing does not include something pertinent to accident prevention. It may be a description or a picture of a gadget, or it may be a feature article—but it is there.

Men and materials must function together safely. The textile-machine bu lder and the textile manufacturer have a responsibility for safety to life and limb which both are meeting—sometimes indirectly and without always realizing it. Modern instrumentation, better control of quality, more efficient production, all go hand in hand with safe operation.

For machine builder, and manufacturer, and worker alike—safety is no accident!

Precision and Accuracy of
ORIFICE-METER INSTALLATIONS[1]

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INTRODUCTION

THE operation of plants for the government's synthetic-rubber program at Baton Rouge, La., during World War II, required that accurate measurements of certain light hydrocarbon streams between these plants and nearby private concerns be provided for accounting purposes. Two identical orifice meters were installed on each of the streams in order to provide normally a double check on the flow quantities and to insure continuous records during the time one meter was down for routine maintenance or overhauling. It was stipulated in the operating contract with the government that the average reading of the two meters would be used for accounting figures and that the deviation between them should not exceed 3 per cent. The dual-meter installations possessed some features not ordinarily found in commercial installations, designed to reduce the metering errors to a minimum. These installations were maintained carefully on a regular schedule and received additional maintenance when it was indicated to be necessary. In addition, the recorder chart from each of the meters was integrated by two persons to serve as a check and, thereby, minimize the error in this operation.

Because of the lack of published data, a study was made of certain of the dual-meter installations to determine the degree of precision and accuracy which can be expected of carefully installed and well-maintained commercial orifice-meter installations. Four of the dual-meter installations, which were located on relatively nonfouling and pulsation-free streams, were chosen for this study. It was possible to examine the accuracy of one of the four installations, since the stream on which it was located was also measured in calibrated drums. It is the purpose of this paper to describe the meter installations and to give the results of this study.

DESCRIPTION OF DUAL ORIFICE-METER INSTALLATIONS

The specifications for the installation of the dual orifice meters included all the principles and details generally recognized as sound orifice-meter practice for the measurement of liquid hydrocarbons. Some features, in addition to those ordinarily found in commercial orifice meters, were included in an attempt to obtain an installation in which the errors were reduced to a minimum, such as, longer than usual metering runs, special precautions to prevent vaporization of the hydrocarbon, and facilities to remove entrained immiscible liquids, gas, or solids from the stream. By following these specifications it was believed that the metering errors would not exceed 1 per cent. The responsibility for seeing that the specifications were adhered to rigidly and that the meters were maintained properly at all times was assigned to one man who was familiar with good metering practices.

A sketch of a typical dual orifice-meter installation is shown in Fig. 1, and an actual installation with the housing omitted is shown in Fig. 2. The stream being metered first passed through a settling drum which served to remove entrained immiscible liquids, gases, and solids. The stream then flowed through a straight section of pipe containing an orifice, and thence through a second straight section to a second orifice identical with the first. By-pass connections permitted either orifice and its metering run to be removed for inspection or changed while the metering installation was in operation. Downstream of the second orifice, provisions were made for obtaining the pressure, temperature, and samples of the stream. Both orifices were equipped with identical seal pots and recording meters. The orifices, seal pots, and recording meters of the four installations under consideration were enclosed in a protective house. Details of the installations are given in the following paragraphs.

Since relatively light liquid hydrocarbons were being handled, the importance of facilities to prevent their flashing was recognized. Where the hydrocarbon was in equilibrium with its vapor, a pump to increase the pressure, or a cooler to decrease the temperature was provided ahead of the metering installation. In those cases where a stream flowed into a region of low pressure (even though a pump or cooler had been provided), and there was the possibility of flashing, a back-pressure regulator was installed downstream of the metering facilities to maintain sufficient pressure on the stream to prevent flashing.

A settling drum was provided upstream of each dual metering installation to separate any entrained gas and water or solid particles which might lodge behind the orifice plate or plug it, even though all the ordinary precautions had been taken previously to prevent these materials from entering the streams. The settling drums were fabricated of 8 or 12-in. pipe with a length of 6 ft, or longer if necessary, to give a minimum settling time of 30 sec. The drums were installed with a slope of 1 in. in 6 ft. A perforated baffle plate was installed near the inlet of each drum to insure good flow distribution and, consequently, good settling conditions for entrained materials. Connections were installed at the high and low points in the drum, downstream of the baffle, for withdrawing trapped gas and water, respectively. During operation the gas and water-withdrawal valves were checked as frequently as was found necessary to prevent the passage of water or gas through the drum. A by-pass line with a block valve was installed around the drum so that operation could be continued in the event the flow-distribution baffle became plugged.

For the main line containing the orifice plate, a minimum size of 2-in. standard pipe was specified, and where a choice of pipe size was possible, it was specified that a larger-diameter pipe be used. A distance of at least 100 pipe diam was provided upstream between the orifice plate and the nearest fitting or

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[1] The work reported in this paper was carried out in plants owned by the Reconstruction Finance Corporation, Office of Rubber Reserve, and operated by the Louisiana Division of Esso Standard Oil in connection with the government's synthetic-rubber program.

Contributed by the Industrial Instruments and Regulators Division and presented at the Annual Meeting, New York, N. Y., November 26–December 1, 1950, of The American Society of Mechanical Engineers.

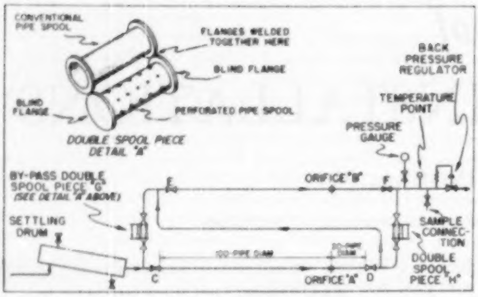

FIG. 1 DIAGRAMMATIC SKETCH OF TYPICAL DUAL ORIFICE-METER INSTALLATION

(Arrows show normal flow through installation. To by-pass orifice A, perforated portion of double pipe spool piece G is removed, conventional spool is substituted, and adjacent block valves are opened. Block valves C and D are closed and orifice and meter runs are available for maintenance. Orifice B is by-passed by switching double spool piece H, opening adjacent block valves, and closing block valves E and F.)

tion, replaced the perforated spool when it was necessary to use the by-pass. The entire piping assembly was placed in a horizontal position at a height of about 7 ft above the grade level. This was done in order that the seal pots and meter body could be installed beneath the orifice and still permit the meter to be at a convenient height for reading the recording chart and doing maintenance work.

The orifice plates were made of $^1/_8$-in-thick stainless steel and conformed with ASME specifications.[2] Before each plate was installed, the bore diameter was measured carefully and checked for sharpness of the upstream edge, roundness, and perpendicularity to the face of the orifice plate. In addition, a check was made to see that the plate was flat and that sufficient clearance existed between the outside orifice-plate diameter and the flange-bolt circle to prevent buckling once the plate reached line operating temperature.

It was expected that the flows through the meters might vary. To take care of variations and at the same time provide accurate measurements, all orifices were designed on the basis of 100-in. range tubes. This afforded the flexibility of changing to a 50 or 200-in. range tube without sacrificing accuracy or changing orifice plates. While discharge coefficients for Beta ratios (ratio of orifice diameter to inside pipe diameter) are readily

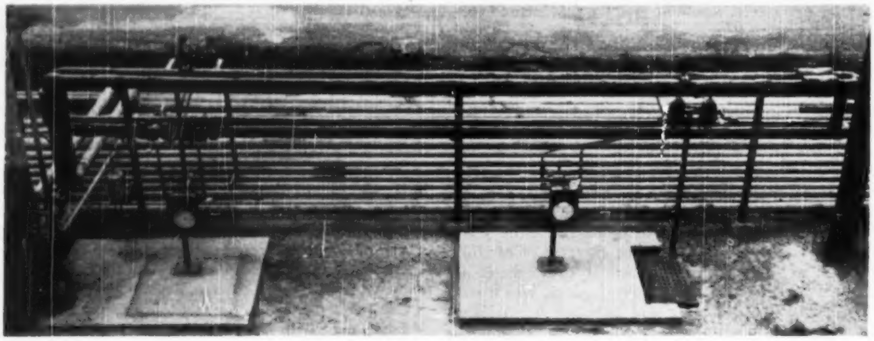

FIG. 2 DUAL ORIFICE-METER INSTALLATION

connection, as compared to the usual commercial specification of 50 diam where maximum accuracy is sought. Similarly, a straight-line section of at least 20 pipe diam was installed downstream of the orifice plate, as compared with the 10 diam usually specified. The inside of the piping chosen for the orifice runs was cleaned by sandblasting so that its condition could be checked for uniformity and smoothness. Where the specified upstream run of 100 pipe diam resulted in a section of pipe longer than the normal length (20 to 22 ft), two sections were butt-welded together. When possible, the weld was ground flush with the inside of the pipe. In all cases the weld was installed the full pipe-length distance, i.e., 20 to 22 ft, from the orifice.

In Fig. 1 it will be noted that the piping of the dual-meter installations was so arranged that either orifice and attendant pipe runs could be by-passed and removed from service for inspection or changes while the other meter remained in operation. The by-pass line around each orifice was equipped with double block valves separated by a short piping spool piece. When the orifice meter was in service, a spool piece fabricated of blind flanges with $^1/_8$-in. holes drilled in the pipe (see detail A, Fig. 1) was installed between the cocks which readily demonstrated that no fluid was going through the by-pass. A second spool piece, identical in length and of normal construc-

available between the limits of 0.1 to 0.7–0.75, an effort was made to keep the Beta ratios for the orifices used in the dual metering installations within the limits of 0.25 to 0.6, since discharge coefficients[3] within these limits have been determined experimentally. In evaluating Beta, the inside diameter of the pipe was calipered at a distance of 4 diam preceding the orifice, and the arithmetic mean of the values obtained was used as the inside pipe diameter.

The orifice flanges were the threaded type with the pipe inserted so that its end was flush with the face of the flange. The flanges were installed with the pressure taps in the horizontal position. The pipe was examined and any burrs resulting from these operations were removed. Care was taken in the installation of the orifice to be sure that the gasket material did not project into the pipe, that the gaskets and orifice plate were properly centered, and that the flange bolts were tightened evenly to prevent buckling of the plate.

In the dual-meter installations, local recording mercury

[2] "Flow Measurements by Means of Standardized Nozzles and Orifice Plates," ASME, 1940, 66 pp.

[3] The coefficients of discharge were obtained from "Report of ASME Special Research Committee on Fluid Meters," ASME, part 1; fourth edition, 1937.

TABLE 1 PHYSICAL CHARACTERISTICS OF DUAL-METER INSTALLATIONS

Stream[a]	Nominal line size, D_1, in.	Measured orifice size, D_2, in.	Beta ratio, D_2/D_1	Range-tube size, in. of water	Approximate flow-pen reading[b]
A, Isobutylene product (Jan., 1944–April, 1945)	3	1.100	0.359	100	6
A, Isobutylene product (Jan., 1948–Dec., 1948)	3	1.228	0.400	50 & 100	5–7
B, n-butylene feed (Jan., 1944–April, 1945)	3	1.300	0.424	100	5
C, Mixed butylenes (Jan., 1944–April, 1945)	3	0.883	0.289	100	6
D, Butadiene product (Jan., 1944–April, 1945)	6	3.000	0.495	100	5
D, Butadiene product (Jan., 1946–Sept., 1947)	6	3.000	0.495	100	5

[a] A, B, C, and D represent the streams measured by four dual-meter installations from which data were obtained.
[b] Reading on a 10-division square-root-type chart used on the flow recorders.

meters were used; neither remote-recording nor flow-control-type instruments were permitted, because of the greater error inherent in using them. Each metering assembly was equipped with 6-in-diam seal pots using water as the sealing liquid. The piping manifolds on the meters and seal pots were designed to facilitate zeroing and calibrating the meters. The lengths of these piping manifolds were kept to a minimum.

The necessary facilities for obtaining the pressure, temperature, and a composite sample of the liquid hydrocarbon were provided at least 20 diam downstream from the second orifice. The line diameter was increased to at least 6 in. at the point where the thermowell was installed to provide adequate immersion of the temperature-measuring device. The piping of the four meter installations under consideration in this paper was arranged so that the orifices, seal pots, and recorders were enclosed in a house which could be heated during cold weather and thereby minimize temperature changes and provide maximum convenience for meter operation and maintenance. The pressure and sample connections were extended into the house.

The more important physical characteristics of the four dual-metering installations used in obtaining the data for this study are shown in Table 1.

MAINTENANCE OF INSTALLATIONS

A maintenance schedule was specified for the dual-metering installations which included the following: (1) A daily zero check of each meter under operating pressure; (2) a complete check of the meter, followed by calibration[4] once every 3 months; (3) examination of the orifice plates and upstream and downstream-meter runs at intervals, depending upon the service of the meter. The meters were given complete checks and calibrations more often than the scheduled 3 months if their daily records or other reliable methods indicated one or both meters to be in error. It was the practice to overhaul or calibrate the meters when the deviation between them exceeded the specified maximum tolerance of 3 per cent over a period of 2 or more consecutive days.

It is believed that the maintenance schedule was adequate and that even if considerably more effort had been expended in maintaining the meters, closer agreement could not have been obtained between the meters. This is based on the fact that it was seldom necessary to adjust these meters on the daily zero check or the 3 months' calibration.

[4] The metering installation was checked for such things as condition of the pen-shaft packing, cleanliness of the mercury, range tube and float chamber, and correct arcing of the recorder pen, after which the meter was calibrated against a water column.

SELECTION OF DATA

The records obtained during certain periods from January, 1944, through December, 1948, on four of the dual orifice-meter installations were chosen for this study. These particular installations were selected because of their freedom from pulsations and wide variations in flow, which make good measurements very difficult. In examining the charts from these installations, it was realized that certain of the charts would have to be excluded if the study were to be considered representative of normal meter performance.

Thus charts were excluded for any of the following three reasons:

1 Either one or both of the charts were incomplete due to plant shutdown, calibration of the meter, clock stopping, failure of pen to ink, etc.

2 The flow-pen reading was below 3 on the 10-division square-root chart.

3 The indicated flow rate was not in agreement with rates based upon known process outputs or other reliable secondary checks.

Charts with flow-pen readings below 3 were not included because of the high-percentage error encountered in planimetering charts with low pen readings. When it was anticipated that the pen reading would be as low as 3 for any period of time, the range tube or orifice plate changes necessary to give higher pen readings were made. Exclusions for the reasons mentioned in category 3 were infrequent (being zero for some of the installations) and were usually due to leakage of the seal fluid from the pots or to blowing the mercury from the meter.

It was found necessary to exclude only about 10 per cent of the charts obtained for the periods under consideration for all of the reasons previously stated. The total of 2544 sets of dual-meter charts, which remained after the exclusions, were used as a basis for this study.

The 10-division square-root chart records from the dual meters were integrated with square-root-type planimeters provided by the meter manufacturer for use with these charts. Each of the charts was integrated by two clerks. If the deviation between the readings obtained by the two clerks did not exceed 0.03 (i.e., approximately 1 per cent at a chart reading of 3, and 0.4 per cent at a chart reading of 8), the average of the two readings was used as the final value of the pen reading for the chart. When the readings did differ by more than 0.03, they were checked until satisfactory agreements were obtained. However, this was seldom necessary, as the deviation was normally less than the maximum allowed.

TABLE 2 SUMMARY OF PRECISION AND ACCURACY RESULTS OBTAINED WITH DUAL-ORIFICE INSTALLATIONS

Stream	Number of sets of records	Agreement ratios: Average	Minimum	Maximum	Per cent of records for which agreement ratio is that within indicated range: 99.8–100.2	99.5–100.5	99.0–101.0	98.5–101.5	98.0–102.0	97.0–103.0
A,[a] Isobutylene product (Jan., 1944–April, 1945)	450	99.7	87.3	102.8	37.4	59.9	80.8	92.0	94.2	97.2
A,[a] Isobutylene product (Jan., 1948–Dec., 1948)	329	99.5	96.8	101.9	28.1	58.8	85.9	92.5	96.1	99.7
B,[a] n-butylene feed (Jan., 1944–April, 1945)	410	99.9	95.9	102.4	25.5	54.4	81.2	95.5	98.9	99.6
C,[a] Mixed butylenes (Jan., 1944–April, 1945)	361	99.6	95.1	103.9	27.8	55.8	77.4	87.4	94.7	98.1
D,[a] Butadiene product (Jan., 1944–April, 1945)	413	99.7	97.8	102.2	31.5	63.3	93.6	97.9	99.8	100.0
D,[a] Butadiene product (Jan., 1946–Sept., 1947)	581	99.9	98.4	102.9	38.3	70.9	93.1	98.6	99.6	100.0
D,[b] Butadiene product (Jan., 1946–Sept., 1947)	580	99.3	96.5	104.3	16.9	33.3	61.4	81.9	94.6	99.6

[a] Represents data for agreement ratios between the dual meters.
[b] Represents data for agreement ratio between average of the two meters on this stream and corresponding records for a calibrated receiving drum.

PRECISION OF METERS

In determining the degree of precision or reproducibility which can be expected of orifice meters, the 2544 sets of charts were used to calculate percentage-agreement ratios between the dual meters. The agreement ratios were computed in all cases by dividing the chart reading of the first meter in the installation by the chart reading of the second and multiplying by 100 to obtain percentages expressed to the nearest 0.1 per cent. The resulting figures were used as a measure of the precision of the meters. Table 2 shows the number of sets of records obtained, the average, minimum, and maximum agreement ratios, and the percentage of the sets of records for which the agreement ratio fell within prescribed ranges. It is interesting to note that Stream A during the period January, 1944, through April, 1945, was the only one of the installations for which the largest deviation exceeded 5 per cent (agreement ratio of 95 or 105 per cent), and for that installation the deviation exceeded the maximum allowable deviation of 3 per cent only 2.8 per cent of the time. Data obtained on this same installation for the year 1948 showed a maximum deviation of 3.2 per cent. These data serve to illustrate the degree of precision or reproducibility which can be achieved with properly installed and maintained orifice meters. The curve in Fig. 3, which is based on Table 2, further emphasizes the precision possible, showing that for 85 per cent of the 2544 sets of records the deviation was 1 per cent or less, and that for 99.2 per cent of the records the deviation was 3 per cent or less.

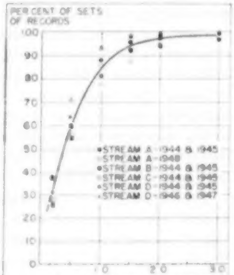

FIG. 3 DEVIATION OF DUAL-METER AGREEMENT RATIOS FROM 100 PER CENT

(Materials corresponding to Streams A, B, C, and D are shown in Table 1.)

The percentage-agreement ratio data for the four dual installations during the period January, 1944, through April, 1945, are shown in Fig. 4 and indicate the precision or reproducibility of each of the installations. In Fig. 5 frequency distributions are used to compare the precision of the Stream A dual installation during the period January, 1944, through April, 1945, with the year 1948. The general agreement in the shape of the two curves and the fact that the average agreement ratio was 99.7 per cent during the first period and 99.5 per cent during the second indicate there was no appreciable change in the precision of the installation over the 4-year period.

As can be seen from Figs. 4 and 5, the most frequent percentage ratio is also very nearly the average percentage ratio. This is characteristic of the frequency-distribution-type curve and is indicative that at least a certain amount of the disagreement in the measurements obtained with the two meters on the same stream is due to random error in any of several items entering into the determination of the meter records. The fact that the average percentage ratio and the most frequent percentage ratio are displaced from 100 per cent is evidence of there being a slight physical difference between the two individual meter setups comprising the dual installations, or a slight difference in the stream conditions at the two meters. It will be noted that in all cases the average agreement ratio was slightly below 100 per cent, meaning that on the average the first meter read lower than the second. No explanation has been found.

ACCURACY OF METERS

To establish the accuracy of a dual orifice-meter installation, the quantities as determined by the dual-meter installation on Stream D were compared to the quantities as determined from gage readings on calibrated receiving drums. The recording meters used in this service were provided with 2-hr clocks to aid in obtaining accurate measurements, since each movement was of approximately 1 hr and 45 min. duration. The hydrocarbon stream delivered through these meters was received in 10-ft-diam × 50-ft-long horizontal drums equipped with gage glasses which could be read to the nearest $^1/_4$ in. Since the level change in each shipment was about 5 ft, the probable error would be in the order of ±0.2 per cent. The shipments were scheduled so that the opening and closing gages on the drums were at about the same level for each shipment, and the drums were blocked off from all other equipment.

The period January, 1946, through September, 1947, was chosen for this phase of the study, as the receiving drums were carefully water-calibrated in the latter part of 1945. In the bottom line of Table 2 are shown the agreement ratios between the average of the two meters and gages on the receiving drums for 580 hydrocarbon movements made in this period from January, 1946, to September, 1947. It can be seen that for 61.4 per cent of the movements the deviations between the average of the dual meters and the drum gages was 1 per cent or less, and that for 99.6 per cent of the movements the deviation was 3 per cent or less. The average agreement of 99.3 per cent

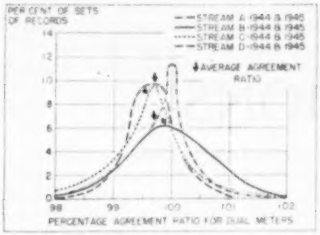

FIG. 4 FREQUENCY DISTRIBUTIONS FOR AGREEMENT RATIOS OF FOUR DUAL-METER INSTALLATIONS

(Materials corresponding to Streams A, B, C, and D are shown in Table 1.)

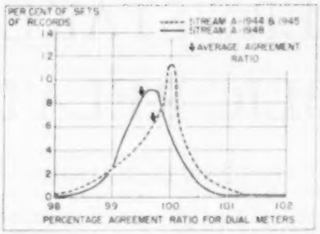

FIG. 5 FREQUENCY DISTRIBUTIONS COMPARING PRECISION OF DUAL-METER INSTALLATION DURING TWO PERIODS

(Material corresponding to Stream A is shown in Table 1.)

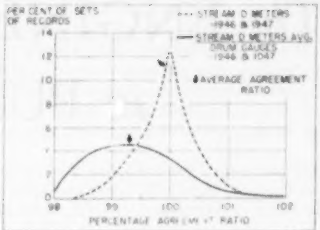

FIG. 6 FREQUENCY DISTRIBUTIONS ILLUSTRATING ACCURACY OF DUAL-METER INSTALLATION

(Material corresponding to Stream D is shown in Table 1.)

between the dual meters and the drum gages is indicative of the accuracy of the dual-meter installation. It is interesting to note that during this period the average agreement between the two meters was 99.9 per cent.

In Fig. 6 are presented smooth frequency distributions showing the percentage agreements between the two meter readings and between the average of the meter readings and the drum gages. It will be noted that the two curves are, in general, of the same type but that the curve representing the agreement between the average of the meters and the drum gages shows greater dispersion. The standard deviations for the agreement ratios between the two meters and between the average of the meters and the drum gages are 0.57 and 0.89 per cent, respectively. It would be expected from the close agreement between the two meters that the relationship between the average meter reading and the "absolute" accurate flow value should be essentially constant, subject only to the influence of random errors.

Thus it does not appear unreasonable that errors were more frequently made on taking drum-gage readings, possibly due to the human element, or that factors other than the drum-gage readings slightly influenced the reliability of the drum as a measure of absolute accuracy. Therefore it is concluded that the precision of the orifice meters was greater than that of the results obtained from drum-gage readings.

CONCLUSIONS

From this study the following conclusions were reached:

1 The dual orifice meters installed as described herein are satisfactory for measuring liquid-hydrocarbon streams.

2 The precision of orifice-meter installations can be sustained over long periods of time with proper maintenance.

3 The deviation between dual orifice meters which are properly installed and adequately maintained can be held at 1 per cent or less for 85 per cent of the time, and 3 per cent or less for more than 99 per cent of the time, with an average deviation in the order 0.1 to 0.5 per cent.

4 The accuracy, using dual orifice meters, can be maintained within 1 per cent or less for about 60 per cent of the time and within 3 per cent or less for more than 99 per cent of the time, with an average accuracy within 1 per cent.

5 The measurements of the dual orifice meters on Stream D were more precise than those of the gages on the water-calibrated receiving drums on the same stream.

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Grinding Fluids

(Continued from page 965)

impressions would be due to the presence of particles having a minimum dimension less than 0.5 mm.

SUMMARY

1 A method of accurately recording and measuring metallic wheel loading was devised.

2 This method involved the chemical detection of metallic particles embedded on the surface of the grinding wheel.

3 Photographs of loaded wheels did not give a true indication of actual loading.

4 A further application of this method concerned determination of the effectiveness of wheel dressing.

5 The heavy-duty-type soluble oil indicated least metallic loading of all grinding fluids.

6 The conventional-type soluble oil showed slightly greater wheel loading than the heavy-duty product.

7 Nonpetroleum water-soluble cutting fluids exhibited greater metallic wheel-loading tendencies than soluble oils.

8 With the use of tap water as a grinding fluid, maximum wheel loading was effected.

9 As the dilution of the grinding fluid was increased, the resultant metallic-wheel-loading tendencies increased proportionately.

10 In general, the particle size of the embedded metal increased as the dilution of the grinding fluid became greater.

11 The metallic particles were larger when grinding with the soft draggy SAE 1020 steel than with the Type 416 stainless steel.

12 Since the selection of grinding fluid influenced wheel loading to such a marked extent, it appeared that the grinding fluid was one of the most critical factors in effecting efficient grinding.

13 Some indications were obtained showing that power consumption and wheel wear increased with the degree of metallic wheel loading.

The ENGINEER'S STAKE *in* PUBLIC RELATIONS

By JOHN D. WAUGH

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COMPARED to the struggles of other professions for favorable public recognition, engineering is twice blessed. Both its origin and its recent past have bequeathed it a favorable, though not prominent, public standing. In the minds of people who understand the creed, philosophy, and contributions of engineering, the collective image of the profession is a positive one of objective research, constructive effort, and service to mankind.

Some other professions are haunted by dark symbols created in the past. Doctors shudder at the word "quack." "Shyster" gives the legal profession a chill. "Bloated" capitalist and "cheap" politician are familiar expressions. Leading businessmen and statesmen are not immune to them. The study of word meanings is full of such labels which, through usage, association, and deliberate twisting have become derogatory symbols. Among the leading professions, engineering alone has not been successfully labeled with a negative symbol.

THEORY OF CONDITIONED REFLEXES

The significance of "symbols," i.e., words, sounds, and marks which stand for something else, was first determined by the noted Russian physiologist and Nobel prize winner, Ivan Petrovich Pavlov. Pavlov's discoveries emerged from his experiments which formulated the theory of conditioned reflexes. His experiments, initially conducted on dogs, followed a systematic pattern. A bell was rung and immediately afterward powdered meat was placed in the dog's mouth. The meat evoked a natural reflex in the dog; its mouth watered. When this procedure had been repeated three or four times a day for about ten days, it was found that striking the bell without giving any powdered meat would cause the dog's mouth to water. Thus a conditioned reflex was established in that a specific response followed promptly upon a sensory stimulus which had previously produced no such result.

Applied to humans and simply stated, this means that people are responsive to repeated physiological stimuli, and—more importantly—mental stimuli. The effects of repeated mental stimuli are familiar to all of us. We often hear clangorous radio advertising, having no educational value but accompanied by such insistently repetitive theme songs, catchwords, or just noise, that we learn about the advertised product in spite of making no conscious effort to learn, or even while making a deliberate effort to ignore it.

In essence, what we repeatedly see, hear, read, or experience about specific subjects establishes symbols in our minds for those subjects. Our feelings and expressions on these subjects are automatically released when the symbol is presented.

Symbols—such as names or insignia—may be either good or bad. They will vary with the audience and may change character from generation to generation. For example, the Ku Klux Klan was once a tolerated organization identified by an outlandish, but respected, costume. Now, due to a changing sense of values on the part of the public, the hooded figure is a sinister, unwelcome symbol. "Uncle Joe" Stalin once beamed down from posters put up by our Government, here in New York. Now his name and caricature are used to accent alarming situations. Today the UN is a symbol of co-operation and hope, while the Air Force symbolizes protection and power.

COMMERCIAL SYMBOLS

Of less importance in world affairs but of no less significance to their possessors are the kinds of symbols associated with commercial enterprises.

If, for instance, an automobile company today possesses a good symbol, it is due to the practice of sound engineering, good manufacturing, and positive public relations. If the mention of a certain automobile evokes generally favorable comment, it is because the commentator has experienced quality performance and service from his car, or knows of people who have. Additionally, he probably has been well treated by his serviceman, has known employees of the company who were responsible citizens, has read of the accomplishments of the company, seen its advertising, learned of the leadership of its executives, and has come to possess many other opinion-forming facts of a positive nature.

Good symbols do not come into being by happenstance. They evolve from a definite philosophy of doing business. If a product is well designed and efficiently manufactured and can be sold competitively, its favorable acceptance and endorsement of the company behind it are largely accomplished by the practice of good public relations. Likewise, acceptance of an institution or a profession depends not only upon its philosophy and practice but also on repeated positive presentation of its story to the public. In short, if mention of a firm, a product, an institution, or a profession evokes favorable comment from a large number of people, then the symbol of the subject has become respected through repeated friendly associations.

OBSCURITY OF THE ENGINEER

In spite of the generally favorable standing of engineering, there is evidence that the profession is not fully understood and appreciated by the general public. If you were to take a poll of passers-by on the street, asking each of them to name a great engineer, chances are they would scarcely be able to name one. Yet, most of these people could unhesitatingly name a great general, or a great statesman, or a poet, or actor, or even a great scientist.

Chances are that those who could name a great engineer would name one who achieved wide public recognition through some activity other than the practice of his profession. Better-informed members of the public might reply with the names of George Goethals, Julius Krug, Herbert Hoover, or George

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Washington. An engineer can become famous—if he also happens to be President of the United States.

The relative obscurity of one of the most brilliant and original engineers was commented upon lately in the editorial columns of the *New York Herald-Tribune*, in connection with a tribute to William J. Wilgus.

These are excerpts from the editorial:

"In a predominantly engineering civilization—a civilization surrounded and sustained by the works of the engineer, and incapable of living for an hour except as these almost miraculous constructions function as they were intended to do—it is remarkable how few engineers ever reach public prominence.

"We duly honor our poets and statesmen, our philosophers and soldiers and great salesmen and scientists, but we seldom know who our engineers are. William J. Wilgus was well known in New York; yet hardly one in every million who has gone through the Grand Central Terminal or frequented the present Park Avenue can have connected his name with those major improvements, in which his was the inspiring and guiding mind.

"He was an outstanding engineer in an engineering civilization; but civilizations rarely recognize their greatest architects."

This indifference on the part of the public to the significant achievements of engineers is sometimes attributed to the technical nature of the profession. It is said to be too complicated and too remote ever to appeal to public imagination. But in view of the performance of other professions, this argument is not valid.

SCIENTISTS WIDELY RECOGNIZED

Scientists, working in the purely abstract realm, have done a superb job of dramatizing their profession. Harold Urey, Robert Oppenheimer, Vannevar Bush, Harlow Shapley, Roy Chapman Andrews, and at least a dozen more bright lights of science are recognized by large segments of the public. Their stories are told and retold, their counsel is sought, and their advice is very frequently accepted. The very fact of their recognition should dispel the idea that the public is not interested in technical subjects. What the scientists have done is to strip abstract and mathematical subjects of their technical embroidery and explain them in terms of human interest and public benefit. They have recognized their responsibility to the public to interpret their work in terms of what it means to the advance of human knowledge. The attendant benefits of this advance imply progress in national defense, public health, advancing living standards, and many other subjects of general concern and interest. Engineers could do the same thing quite as capably and establish a greatly improved symbol.

Engineers, individually and collectively, have an important stake in improving their public relations so that the profession will achieve wider understanding, with its corollary benefits. Also, greater appreciation will better enable the profession to meet and handle forces which threaten it. The present public understanding of the engineering profession is one of the first factors to consider in planning to improve public understanding.

PUBLIC'S CONCEPT OF THE ENGINEER

Look at the national picture of the engineer fostered by Hollywood. The movies usually show an engineering hero in riding boots, peering through a transit and waving for a building or a bridge to be moved over a little.

Aeronautical engineers depicted in the movies fly their own creations into the wild blue yonder, and on the ground are invariably humped over a drawing board, sweating out an overglamorized artist's conception of an improbable aircraft.

Chemical, mining, and electrical engineers are generally left out in the cold, but now and then they have been portrayed as eccentric individuals possessing some pocket-size gadget that an unscrupulous mob is trying to steal to use against mankind. Automotive engineers have been shown as begoggled auto-race drivers grinding up a dirt track to prove a sensational new unpatented carburetor while a furtive gang is trying to steal the invention.

Advertising portrayals of the engineer have, in general, been more factual and complimentary. However, there have been some awful bobbles due to inadequate research or failure to check on technical details.

At the community level there is widespread misunderstanding of an engineer's function, whatever his field. It has been said that an untold number of wives, when they state that their husbands are engineers, are asked, "With what railroad?" When exact titles are given, such as "stress analyst at the Concrete Airplane Corporation," members of the lay public still do not know what the engineer does. They are not interested in, and will not remember, unusual technical titles. They understand that doctors heal the sick, lawyers guide people's legal relationships, mechanics fix things, and so on. They will have to be told what engineers do to appreciate their place in the scheme of things.

Also in the community there appears to be an insufficient proportion of engineers who take the lead in civic projects, organize worth-while activities, or speak before important civic groups. Program committees often consider technical people a bit dull and pedantic. If an engineer is suggested as a speaker, someone will tell about an engineer he knows, Harry Hemisphere. It is recounted that Harry won't say a ball is round, but will say: "It appears to be round at the prevailing temperature and under existing light conditions, but, without having proper instrumentation and criteria for round balls, I cannot risk my professional integrity by stating that the ball is round."

Though this characterization may be overdrawn, there are many engineers whose analytical talents render them virtually inarticulate and hardly candidates for speaking appearances.

Companies, schools, and local and national engineering societies frequently find it difficult to get eminently qualified engineers to write interesting papers and present them effectively. Lay groups experience the same reticence. One result of this reluctance to lead is that the professional standing of engineering slips relative to the standing of other more active groups. Doctors and lawyers are social, civic, and political-minded because their living depends directly upon the symbol they and their professions maintain.

Practices which may damage the prestige of the engineering profession constitute a leading problem. People who seek to trade on the term "engineer" are blurring the outline of the profession. There are "cosmetic," "display," "promotion," "personnel" and many other so-called engineers. Unless the limits of professional engineering are publicly defined, and this practice discouraged, someday we may find supermarkets with "vegetable engineers."

Students at engineering schools periodically follow "fads" for certain branches of engineering which threaten the college with overstaffing in one field and shortages in others. At the seat of this difficulty is the failure of the profession, collectively, to present accurately the opportunities existing throughout engineering. Every engineer has a vested interest in the appropriate distribution of his fellow members throughout the profession. If there is disillusionment or displacement of engineers, or the profession loses its allure for capable young men, its future growth and standing are imperiled.

TIME FOR PUBLIC-RELATIONS PROGRAM

To meet the problems facing their profession, engineers can undertake a program within the scope of their present activities by applying well-known public-relations principles. The profession is fortunate in having the organization and machinery to conduct a successful program for greater public recognition and appreciation. The national societies, with their experienced headquarters staffs and their network of chapters, form the ready-made organization. The machinery is provided by the general-circulation engineering publications, national, regional, and local meetings programs and flow of paper presentations. What is needed additionally is a representative expression by members that they recognize their stake in public relations and want to do something about it.

An engineering public-relations program should include these objectives:

1 To gain wider public recognition of the role of the engineer in modern society. This would help maintain the prestige of the profession and assure its attraction for the best-qualified young men.

2 To take definite steps in meeting threats to the profession. By making clear the requirements and defining the limits of the profession, shadowland "engineers" can be discouraged from using unqualified titles.

3 To inform engineers how their stake in public relations has a direct bearing on their income and the security and prestige of their positions. The values of participating in social, economic, and political affairs at all levels would be emphasized.

To gain wider public recognition, individual engineers and their societies should draw public attention to the profession itself, through a major, annual, newsmaking event which would represent all of the branches of the profession. Such an event, properly staged, would give the profession an opportunity to reiterate its creed and cite the accomplishments of engineering in terms of public interest. This annual event would serve to draw national attention.

But national attention is not enough. A continuing program should be planned to draw more attention at the community level throughout the year. Steps should be taken to assure engineers that speaking and writing, appearing on radio and television programs, and engaging in civic affairs and other public enterprises are not unfashionable for members of the country's third largest profession. Rather, it should be emphasized that the future standing of the profession may depend upon such activities.

The nationwide public-relations program of the medical profession, in defending itself against socialization, has been hugely successful partly because of the high public standing of many of its members. When these respected and well-known members of the community speak for or against some issue, the standing they have acquired through prior civic activities at the local level lends immeasurable weight to their argument.

To meet threats to the profession, the engineering societies could get together to publicize the extent of the engineer's training and the stringent requirements he must meet. It could be made unpopular for unqualified people to trade on the designation "engineer." Doctors have popularized the intern and his long and intensive training. The legal profession makes a big to-do about how terrifying and tough the bar exams are and how many fail to pass each bar. The Air Force has for years widely broadcast the numbers of student pilots who couldn't pass the supremely difficult air-cadet course. The object of this dwelling upon failures and rough courses is to spotlight the qualifications of the accomplished individual to serve the public.

UNRECOGNIZED QUALITIES OF THE ENGINEER

The public would probably be astonished to learn of the weeding-out process that takes place in the engineering schools. Also, they might be surprised to know of the unpublicized, but difficult, requirements of the State Board professional-engineering examinations. Such requirements as five years' practice of engineering under specified conditions before qualifying for the State Board, among others, should be known more widely. People can be guided to take interest in a professional field that assures such high-caliber men and levels of knowledge.

The individual engineer's stake in public relations can be spelled out in terms of how he will benefit by participation in public affairs. Qualification for management posts is often based on the many facets of a man's personality, seldom on his deep concentration and immersion in one subject. Engineers experienced in dealing with people are often selected to represent their company on important matters. Engineers who become successful in dealing with people, in addition to their understanding of cold materials, are better able to put across engineering ideas and changes, develop personal prestige, and advance to greater engineering responsibility.

Engineering groups all over the country are surrounded by untapped gold mines of information on how their profession can participate in public affairs. Dealers in ideas, editors, writers, commentators, politicians, advertising men, public-relations people, and many others, are generally pleased to appear on engineering programs and explain the nature of their work and its relation to engineering. From these people, engineers can learn how their activities can be related to the public interest.

Within companies, engineers can extend greater co-operation to their advertising, sales, and public-relations departments. Occasionally, engineers suspect that their work will be given a razzle-dazzle treatment by the interpretive departments, so they withhold co-operation. This problem could be resolved, wherever it exists, by articulate engineers taking interest in the interpretation of their work and trying to instruct the other departments. Public-relations departments are perennially looking for technical articles, engineering accomplishments, and publicity items. These people can do much to help in the preparation of interesting articles and frequently can take the curse of stuffiness off technical papers. In companies where this co-operation is requested, engineers receive excellent representation in many company and public activities. Engineers need only seek out this potentially valuable assistance in helping them tell their story.

PUBLIC ROLE OF ENGINEERING

Former President Herbert Hoover recently emphasized engineering's public role and need to tell its story when he said, "The engineer's works are out in the open where all men can see them. He cannot deny he did it. The doctor's mistakes are buried in the grave. The voters forget when the politician changes the alphabetical names of his falling projects. Trees and ivy cover the architect's failures. The lawyers can blame the judge or the jury. Unlike the clergyman, the engineer cannot blame his failures on the devil."

If the engineering profession ever decides to follow a plotted course of improving its public relations, it will again be twice blessed: Because it has done tremendous good and promises to do very much more, and because it is not a pressure group, and the only axe it has to grind is that it wants to be known for the good work it has done and is doing.

The HAZARDS *of* SYNTHETIC PLASTICS

By JOHN V. GRIMALDI

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ESTIMATES indicate that the increasing use of synthetic plastics has not even approached its maximum limits. Such large industries as automobile manufacturing offer a great potential for the employment of plastic products. Even today, a casual inspection of such articles as household appliances points out the current wide use of plastic products for decorative purposes and as a substitute for metals and other materials. The possibilities of plastics may even be beyond the limits of imagination.

FIRE HAZARDS

While "plastics" as a word and as a subject is certainly not new, its growing prominence in the industrial realm recently has focused attention on the fire hazards associated with the manufacture, use, and storage of plastic materials. Perhaps much of the present concern is the result of earlier experiences with pyroxylin, one of the first plastics. The nitrocellulose in pyroxylin burns violently, but most modern plastics do not have rapid-burning characteristics. Many have the quality of being relatively difficult to ignite (except when suspended in air as fine dust). However, because the general term "plastics" is applied to all synthetic and natural organic materials whose principal component is a resinous or cellulose binder and which are capable of being molded or cast, many people think of the fire hazard without regard to the type of plastic involved.

Even though the fire hazard of synthetic plastics may not be considered extreme, and some people may have been concerned unnecessarily, it is important to encourage such respect for hazards. Such attention means the important hazards will be uncovered and given the needed consideration, for accidents, it must be remembered, in the final analysis are always caused by thoughtlessness or unconcern on the part of someone. An understanding, however, of some of the more pronounced fire dangers associated with the manufacture of plastics and the fabrication of plastics products may assist in the directing of safety efforts where they are needed.

The hazards that would be related to plastics manufacturing run the range from the general plant hazards, to the hazards identifiable with the particular materials, such as flammable solvents and dusts, used in the processes. The explosion and fire hazards are greatest in the manufacturing of the resins and in preparing the molding compounds for fabrication purposes. In the coating and laminating processes the use of volatile materials create the principal fire dangers.

In the manufacture of synthetic resins the major equipment used is reaction kettles or autoclaves, involving the heating and refluxing of the reaction mixtures until the required resin formation is achieved. Because the reactions, in general, evolve high heat, control periods are utilized to retard the exothermic character of the reactions. (Inasmuch as the companies manufacturing resins must be staffed with specialists well acquainted with the problems connected with their processes, it would be a presumption to outline those problems here.)

The fabrication of the plastic products presents other hazardous possibilities. Many manufacturers' fabricating plastics may not be so well fortified, as are the resin manufacturers, with special personnel. Therefore, a review of the hazards in this phase of the business may be of value.

OTHER HAZARDS OF MANUFACTURE

Dust and faulty operation at high temperatures and pressures offer the greatest hazards in plastics fabrication. The dust hazards are found in the methods of using and handling molding powders; the tumbling of molded pieces in order to clean and polish them; the machining of molded parts; the cleaning of molds and dies with high-pressure air (also degreasing with flammable solvents during cleaning presents a fire hazard at this time); machine buffing of the molded parts to remove the excess overflow between the mold parting. Hazards are also found in the recovery and control of solvents employed in spraying, dipping, coating and laminating operations. The recovery of solvents often concentrates the impurities present, tending to produce lower boiling mixtures and reduced flash points, and ignition temperatures, than existed for the initial solvent. A properly designed recovery system adds to the safety of the operation for it assures the collection of the volatiles. If they were to be permitted to dissipate, they might cause health and fire hazards. Some of the faith in depending on the physical characteristics of the solvents, as an indication of their behavior, is further shaken when it is realized that although the flash points, boiling points, and ignition temperatures of pure solvents are readily available, the impurities in the secondary or technical grades of solvents used in practice will alter these characteristics. Therefore, it is necessary to obtain this information from the supplier of each solvent or determine it in the laboratory.

CHANGE IN CHARACTERISTICS

Much of the apparent concern over the flammability of plastic materials is not justified, but is the result of unfamiliarity with the chemistry of plastics manufacturing. It is assumed by some that the chemical properties of the finished plastic product are approximately the same as those of the materials from which it was made. For example, when the toxic irritant formaldehyde is reacted with the corrosive liquid, phenol, the result is Bakelite, a solid infusible plastic, with new and different physical and chemical properties. Bakelite always will demonstrate its individual physical and chemical character—not the characteristics of the compounds used in its formulation—until it is acted upon to transform it to another compound. Then the characteristics will be those of the new compound. The phenol-formaldehyde resins are in wide use.

Another type is the vinyl resins which produce translucent

Contributed by the Safety Committee of The American Society of Mechanical Engineers.

materials, which may be colored, such as Vinylite and Geon and are used in sheeting, combs, umbrella handles, etc.

Polystyrene resins produce much the same products as the vinyl resins with the exception that they are not applicable for sheetings. These are known by such names as Cerex, Plexene and Styrons.

The ureaformaldehyde resins have wide popularity. They produce tough lightweight articles, such as the dishes known as Beetle and Plaskon ware.

The methyl methacrylate resins, produced as Lucite and Plexiglas, have wide application in the manufacture of sheeting for airplane cowlings, combs, handles, and the like.

Alkyd resins, such as Glyptal, are in coatings of many types ranging from varnishes to baking enamels.

A well-known plastic—cellulose acetate—is used for making photographic safety film, molded plastics, transparent sheeting, and it is often woven into fabrics. It is frequently known as Tenite and Lumarith.

There are many other resins. Perhaps, the best known of all is Nylon, a diacid-diamide, which is used for brush bristles, thread for hosiery and fabrics, and molded plastics.

Thus it is seen there is a great variety of synthetic resins, yet it must be kept in mind this list is far from complete. As an aid to classifying some of the plastic materials on the market, Table 1 lists selected types of common plastics materials and their trade names.

FLAMMABILITY AND BURNING RATE

In general the synthetic plastics are difficult to ignite in comparison with wood. An exception is the highly flammable pyroxylin—more commonly known as guncotton. Whether a material will burn and at what rate and temperature is a function of its physical form and chemical composition. The physical form may be of greater importance than the composition. For example, a fine powder will burn more readily than a loosely formed mass, which in turn is less difficult to ignite than a solid. The dust from even a slow-burning plastic will explode when confined, under the proper conditions.

The relative flammability of plastics has been determined by the burning rate in inches per minute for an established gage thickness. For example, cellulose nitrate was found to burn at 10–25 ipm, cellulose acetate at 2.0–4.0 ipm, polyethylene 1.1–1.4 ipm, and methyl methacrylate 0.5–1.0 ipm. It is interesting to observe that cellulose acetate has the second most rapid burning rate, even though its ignitibility is low enough for it to be used in the manufacture of safety film. However, in various experiments it has been shown that it is more difficult to ignite than pine wood, leather, or cellophane. Once ignited, the burning rate of cellulose acetate will be dependent upon whether a high-boiling plasticizer has been used. In general, the higher the boiling temperature of the plasticizer the more rapid the burning rate.

The selection of fillers has a great influence on the flammability of a plastic product. Organic fillers, such as cotton, paper, or wood are combustible themselves, while inorganic fillers like mica and asbestos will not burn. All synthetic plastics, with the exception of the silicones, which are largely composed of silica, will burn if the temperature is high enough. Therefore, the flammability of a plastic largely composed of a resin and filler will be greater when the filler is organic than when inorganic filler is used.

An experiment was performed to demonstrate the effect of fillers. A paper-laminated phenolic was found at the time to ignite at the same temperature as cellulose acetate, 1100 F. A molded phenolic plastic with a wood-flour filler required a higher temperature to ignite. An asbestos-filled molded phenolic needed the highest temperature of all, 1500 F before it would burn.

KNOWLEDGE OF PLASTICS COMBUSTION PROCESSES NECESSARY

Fire problems cannot be limited to the understanding and safeguarding of flammables, for when these materials do burn, it is necessary for the fire fighters to have a knowledge of the toxic products of combustion. The composition of the plastic determines the decomposition products of burning.

The burning process takes place in three steps:

1 A destructive distillation of the material, producing gases whose nature depends on the composition of the plastic.

2 Uniting of oxygen with free carbon to form carbon monoxide. At this time dense smoke is usually formed, presenting the additional smoke hazards.

3 When sufficient oxygen (more air) is present it combines with the flammable gases, produced in step 1, as well as the carbon monoxide from step 2. When there is enough air available to combine with all the combustible materials the carbon monoxide burns to form the relatively harmless carbon dioxide. Ordinarily, the products of complete combustion are less harmful than those of incomplete burning. The investigation of the possible generation of hazardous gases from overheated plastics is very incomplete.

However, knowledge of the composition of a plastic will lead to reasonably accurate approximations of its decomposition products.

CONCENTRATION OF GASES FROM BURNING PLASTICS

For example, cellulose acetate and certain vinyl plastics when incompletely burned produce acetic acid—an unpleasant irritating vapor when breathed. In general, nitrogen-containing plastics, such as the urea, melamine, and aniline formaldehydes produce hydrogen cyanide and ammonia when incompletely burned. An indication of the relative toxicity of these decomposition products may be given by the recommended maximum allowable concentrations for each.[1] These limits are based on a daily exposure of 8 hr. For hydrogen cyanide, the permissible safe limit is 10 ppm of air. For ammonia it is 100 ppm, for acetic acid, 10 ppm, and for carbon monoxide it is 100 ppm.

The phenol-formaldehyde plastics, when overheated, will produce some phenol and formaldehyde. The maximum allowable concentration for formaldehyde is 5 ppm. Although liquid phenol (carbolic acid) is a poison, no allowable concentration for its vapor has been recommended.

The chloride-containing plastics, such as vinyl chloride and vinylidene chloride, when partially decomposed by overheating, will give off hydrochloric acid whose vapors are very caustic and irritating. The maximum allowable concentration is 5 ppm.

The plastics partially composed of glycerine, such as certain of the alkyd resins, may, when heated, decompose to give the highly toxic product, acrolein. This product has a maximum allowable concentration of 0.5 ppm.

SUMMARY

The extreme concern over the fire hazards of synthetic plastics probably has arisen out of the experiences with pyroxylin in the early days of the plastics industry. It is probably safe to say that the greatest hazards exist in the manufacture of the resins, in the fabrication of plastic products, and in the grinding of scrap plastic. The burning of most of the plastics themselves should not cause any more concern than the burning of

[1] "Threshold Limit Values," *Arch Industrial Hygiene and Occupational Medicine*, vol. 2 no. 1, July, 1950, p. 98.

TABLE 1 SELECTED TYPES OF PLASTICS AND THEIR COMMERCIAL NAMES

Acrylic:		
	Acryloid	Exelon
	Acrysol	Palatone
	Challenger	Rhoplex
	Crystalex	RX 39
	Crystalite	Trulite
	Crystolex	Vermonite
		Vernonite
Alkyd:		
	Amberlac	Glyptal
	Aquaplex	Mirasol
	Aroplaz	Paraplex
	Beckosol	Rauxone
	Dulux	Syntex
	Dyal	Teglac
Aniline-formaldehyde:		
	Dilectene	
Cellulose acetate:		
	Acele	Gemlite
	Acelose	Inceloid
	Aceplus	Kodapak
	Aero Quality Lumarith	Louvered
	Amer-glo	Lumarith
	Ampacet	Macite
	Antisol	Marolin
	Cellucele	Nixon C.A.
	Cellulate	Nixonite
	Celluplastic	Plastacele
	Cell-O-Glass	Plasticoil
	Charmour	Plastilite
	Cinelin	Plastitube
	Clair de Lune	Plastrim
	Clearsite	Rexenite
	Cloisonnette	R-V-Lite
	Dulcel	Safety Samson
	Enameloid Cloisonne	Safeway cord
	Fibestos	Sundora
	Gemlike	Tec
		Tenite
Cellulose nitrate:		
	Aceloid	Fiberlac
	Amer-glo	Herculoid
	Amerith	Hycoloid
	Celluloid	Kodafilm
	Celluvarno	Kodaloid
	Lusterloid	Plastine
	Nitron	Pyraheel
	Nixon C.N.	Pyralin
	Nixonoid	Pyra-Shell
		Simco
Formaldehyde:		
	P.A.C.	
Hard rubber:		
	Cohardite	Navy
	Luzerne	Rub-Tex
Melamine:		
	Plaskon melamine	
Melamine-formaldehyde:		
	Melantine	
	Melmac	
Methyl methacrylate:		
	Livetone	Lucitone
	Lucite	Ora-Crylic
		Platex
Phenol-formaldehyde:		
	Aquapearl	Heresite
	Bakelite	Indur
	Catabond	Kellite
	Catalin	Lamitex
	Duraloy	Synvar-Ite P
	Durez	Uniplast
Phenolic:		
	Aqualite	Coltwood
	Acrolite	Duraloy
	Arofene	Haveg
	Avtex	MIC
	Beckacite	Micarta
	Coltrock	Super Beckacite
		Tego
Polyethylene:		
	CW-Telcon	Pearlon
	CW-Telcothene	Polythene
Polystyrene:		
	Amphenol	Styrex
	Lustron	Styrite
	Plexene	Styrofoam
	Styramic	Styron
		Styron 411
Polyvinyl acetate:		
	Solvar	
Pyroxylin:		
	Book Tex	Russialoid
	Ivaleur	Zaflex
	Resisto	Zakaf
	Rocoteen	Zapon
Synthetic rubber (butadiene):		
	Ameripol	Chemigum
	Buna N. (butadiene-acrylonitrile)	GR-s (butadiene-styrene)
	Buna S. (butadiene-styrene)	Hycar OR-15, OR-25, OS-10
Urea-formaldehyde:		
	Beckamine	Plaskon
	Beetle	Pliofoam
	Bu Cre A	Plyamine
	Cibanoid	Rauxite
	Lauxite	Synvar-Ite U
		Urac
Ureas:		
	Arodure	
Vinyl:		
	Alvar	Cell-O-Silver
	Butvar	

wood, woolen fabrics, or fats and oils. Some plastics such as vinyl chloride, do not support combustion but must be kept lighted by a separate source of heat.

The toxic products of combustion, while they must be considered, are for the most part of no greater danger than carbon monoxide, and this compound must be considered in the case of any fire. Concerning the other toxic products, the more common materials just mentioned will produce poisonous compounds when burned which are similar to those produced by the various types of plastics. Wood while burning will produce formaldehyde and acetic acid in fractions of a per cent. Wool will give off hydrogen cyanide, as will silk, leather, and cheese also. Butter and fat will give off acrolein under conditions of incomplete combustion.

In summation, therefore, it can be said that plastics probably are not deserving of any more concern from the standpoint of safety than are many other compounds. But lest anyone be lulled into a complete sense of security, it should be remembered that "preparedness" is still the only safeguard against the unexpected.

ECONOMIC MODEL-BUILDING[1]

By ROBERT SOLOW

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DR. KLEIN'S stated objective in this book[2] is an ambitious one: "to estimate laws of human behavior in economic life." And the laws to which he refers are not the abstract, almost shapeless, generalizations of formal economic theory, but exact quantitative relations from which numerical forecasts of such aggregate economic variables as gross national product and total employment can be made. "Exact" is of course the wrong word; nobody, least of all the author, expects his prediction equations to hold without error. There are at least three important reasons for this. In the first place, the economy is surely far too complicated a thing to be describable in any manageable system of linear equations so that many variables and nonlinearities must be omitted from consideration entirely. The most one can hope to do is catch the important effects. Secondly, there may very well be a residuum of economic behavior which is in any realistic way hopelessly unpredictable. And finally the measurements on which Klein's models are based and with which forecasts must be compared are subject to an unknown margin of error of observation. This branch of economics is a statistical science; at best one can state limits within which the errors may be expected to fall with a specified probability.

Underlying such work as Klein's is the view that the economic system can be described (within the foregoing limits) by a set of simultaneous equations expressing all the interrelationships among the measurable economic magnitudes which guide and are the results of economic behavior. Originally these equations describe the behavior of single firms or households, but for practical purposes it is obviously necessary to aggregate and deal with national totals and index numbers. The variables appearing in the aggregate equations are classified into two types which have come to be called endogenous and exogenous. The former are those variables which are determined within the system of economic forces in a narrow sense; they include such things as prices, rents, output, employment. Exogenous variables are those which for the purpose at hand are considered to be extraeconomic and determined by natural, technological, or institutional forces. Examples might be such things as weather conditions and crop yields, population growth, as well as political decisions as to tax rates and the like. This division is primarily one of convenience and may change with the purposes of the investigation, as consideration of such things as population and labor force will show.

A model of the economic system is theoretically complete when one has written down as many independent and consistent equations as there are endogenous variables. For then if the values of the exogenous variables are given the system will determine values for the endogenous variables we are trying to explain. A typical equation of such a system might read

$$I = b_0 + b_1S + b_2S_{-1} + b_3K_{-1} + b_4t + u$$

where I is net business investment in plant and equipment in a given year, S is sales, S_{-1} is sales of the previous year, K_{-1} is the stock of business fixed capital at the end of the previous year, t is a time trend, and u is a random element. It is supposed that a large stock of fixed capital in existence, relative to sales, will discourage further investment. The lagged sales are introduced in the hope that the level and rate of change of sales will give some measure of a business firm's expectations as to the future course of sales, since it is these expectations which are the real determinants of investment decisions. The main statistical task is to find the best possible values of the structural constants b_0, b_1, b_2, b_3, b_4, from data for the interwar period in the United States.

This view of the economic system as a set of simultaneous equations goes back at least to the end of the nineteenth century and such continental economists as Walras and Pareto. But practical attempts at actually estimating the form of the relations making up such a system is a fairly recent thing. Should the experiment prove relatively successful (and Klein would be the first to admit that his own work is only preliminary) it may be expected that more research effort will be expended in this direction. For some ability to forecast at least for short periods ahead is a prerequisite to any attempt consciously to maintain a satisfactory level and rate of growth of national income and employment.

The first more-than-primitive effort to construct a quantitative model of the economic system as a whole was made just about ten years ago by the Dutch economist Jan Tinbergen.[3] Since Klein's book is in his own words "written in the spirit of Tinbergen's investigations and is intended as an improvement and extension of his results," it is instructive to compare the two books to see what progress has been made in the intervening decade.

One noticeable difference between Klein's work and Tinbergen's appears in Klein's second chapter on Economic Theory, which has no real counterpart in the earlier book. In approaching the model-building task it is not very difficult (though by no means obvious) to choose the variables one wishes to investigate and, if possible, explain. But to decide which variables ought to appear in which equations, that is, which economic quantities serve to determine which others, is not always so clear-cut. Klein's method is to return to the classical economic theory of the individual firm and household. He derives the profit-maximizing and satisfaction-maximizing equations and from these finds the demand functions for consumers' goods and for factors of production. These he aggregates to get the equations of his models. Of course, economic theory specifies only very vaguely the shapes of the functions involved and hardly limits at all the variables which may appear. Klein uses index numbers as proxies to represent what are really distinguishable quantities, and in every case he takes linear approximations to the relevant ranges of the unknown functional relationships. These universally used devices are a concession to the computational and statistical problems which inevitably arise. Klein also deals with the more recent theory of the firm which abandons profit-maximization to suppose that a business firm judges its own operations

[1] One of a series of reviews of current economic literature affecting engineering, prepared by members of the Department of Economics and Social Science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Opinions expressed are those of the reviewer.

[2] "Economic Fluctuations in the United States," 1921–1941, by Lawrence Klein, John Wiley and Sons, New York, N. Y., 1950.

[3] "Statistical Testing of Business Cycle Theories," Vol. II, "Business Cycles in the United States of America, 1919–1932," League of Nations, Geneva, 1939.

in a way which depends on characteristics of the balance sheet as well as the income statement. Tinbergen's procedure was different. He chose his explanatory variables in a common-sense way which, while unlikely to go astray, is probably less desirable than Klein's more systematic method. The latter also has the advantage of allowing an interplay between the statistical results and the underlying theory from which both can benefit.

On the theoretical level there is another interesting difference. Although his book is, according to its title, about economic fluctuations, Klein engages in what would be called business-cycle theory at only one point (pp. 76–77) and then only for one page. Tinbergen devoted himself to constructing a model which would out of its own internal dynamics produce more or less regular oscillations, business cycles; Klein is interested in explaining the level of income and economic activity and the cycle is incidental. This change in emphasis can probably be ascribed to the influence of Keynes. Tinbergen, in 1939, wrote as a pre-Keynesian. Today even a great deal of non-Keynesian literature is in the tradition of income analysis stimulated by Keynes.

Turning to the statistical side, there are two ways in which Klein's work marks an advance over Tinbergen's. In the first place, the amount and quality of the available raw data have improved considerably. It is not just the fact that now, ten years later, we have longer series with which to work; but more importantly, government agencies collect many more economic measurements, and collect them at least roughly in such a way that economists can use them. For example, Tinbergen was forced to use figures on iron and steel output as a measure of investment in plant and equipment; Klein has at his disposal a series on gross expenditures on private non-agricultural plant and equipment.

As for statistical methods themselves, Tinbergen estimated his prediction equations in the ordinary least-squares way, one equation at a time. We now know, from the work of Haavelmo, Koopmans, and others at the Cowles Commission for Research in Economics, that this classical method is inappropriate for dealing with systems of simultaneous equations and leads to biased errors. Klein makes use of newer methods of estimation designed to meet this difficulty. He also gives the single-equation least-squares estimates for comparison. Among the problems raised by the new methods, not the least is the length and laboriousness of the computations they require; this limits their usefulness. Another problem which besets econometricians is multicollinearity, the fact that economic magnitudes move together in roughly the same time patterns so that it may not be possible to disentangle their separate influences in the equations of a system. Tinbergen paid a great deal of attention to this problem; Klein is aware of it, but neglects it.

The heart of Klein's book is chapter 3 which contains the models themselves. The first two are small-scale systems, set up for the purpose of trying out certain hypotheses about economic behavior. The first model contains three behavior equations: one determining the volume of consumption, one determining the volume of investment, and one describing the demand for labor; plus, of course, the required definitions. The propositions to be tested are, first, that consumption expenditure as a whole is significantly affected by the division of income between wages and profits, and secondly that the volume of investment depends on the level and rate of change of profits. The answer seems to be that the observed data are consistent with both these hypotheses. However, the question probably ought not to be considered closed until further and more refined work has been done, especially with data of more recent origin than 1941. Model II tests the hypotheses that investment is exogenous and that the stock of cash balances is a variable affecting consumers' behavior patterns. Klein finds that the former hypothesis is not rejected by the data. Thus he has not been able to discriminate between this hypothesis and the one tested in the first model. The proposition about cash balances is frequently made; Klein finds that his data offer it little or no support.

The third model is a much larger affair; it contains twelve structural or behavior equations, together with the requisite definitions. One of the interesting methodological aspects of this model is that it contains a number of equations exploring the housing market and the money market in considerable detail. This offers certain possibilities for industrial research. It may very well be true (though it will take considerable experimentation to settle the question) that market forecasts and other problems referring to a single industry are best computed in the context of a model which takes account of the economy as a whole and perhaps also of a related market. Two prerequisites for this approach to be useful are, first, some degree of agreement about the appropriate model to use for the economy as a whole, and also the availability of a relatively cheap computational routine.

Among the questions which can be tested in terms of Klein's big model is that as to the importance of liquidity as a determinant of investment decisions. Klein's answer is again a tentative negative. It should not be overlooked that the answer to any such question as this is necessarily a conditional one, relative to the model in which the question is asked. Klein is fully aware of the fact that more than one hypothesis about a given economic question may be compatible with a particular model.

The tentativeness of most of the conclusions reached in this book is explainable by the exploratory nature of the work. In econometric model-building, as elsewhere, trial and error is an essential part of progress; general propositions are most likely to suggest themselves after particular cases have been worked out in detail. It is unfortunately true that to apply the best available statistical techniques to systems of equations large enough to be realistic is computationally so expensive as to be beyond the reach of individual research workers. This hampers the needed experimentation.

It scarcely need be said that this is not a book for the general reader, nor does it give a complete or rounded picture of econometric methods. But the specialist in statistical analysis or market forecasting may find it provocative.

THE application of technological improvements to equipment has improved the productivity of direct operations, according to a speech made by Guerard Mackey, E. I. du Pont de Nemours & Company, before the annual meeting of the Society for the Advancement of Management. In accomplishing this, he said, the introduction of more, and in some cases, very complex equipment has increased the past ratios of indirect to direct personnel. This increase in indirect personnel has been particularly felt in maintenance work. For example, in the du Pont Company, the investment per employee has risen from $9500 to $17,000, almost doubled, in the past 20 years. This increased investment per man has resulted in many of our better things for better living and at the same time made working conditions much better. On the other hand, this increased investment per employee, coupled with higher wages, necessitates maximum machine speeds and productivity. The combined effect of all these factors has made maintenance costs soar.

Consequently, it is time that the same intensified effort be given to reducing maintenance costs as has been given in the past to reducing direct labor costs.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

COMPILED AND EDITED BY J. J. JAKLITSCH, JR.

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context and credit to original sources is given.

Civil Defense

BECAUSE of developments in this air-atomic age, leaving the United States open to the danger of sudden devastating attack, the National Security Resources Board has prepared a plan "United States Civil Defense" for organizing the civil defense of the United States.

Since there can be no absolutely military defense, the report points out, an effective civil defense is vital to the future security of the United States because it might provide the means whereby this country, if suddenly attacked, heavily and without warning, could get up off the floor and fight back.

An enemy attack would presumably be aimed at the great metropolitan areas, at the cities and towns, at the country's most critical targets.

Such an attack would be against all the people of the United States, and therefore defense against it must require the coordinated effort of the whole nation.

It is expected that such an attack would be partially successful. Whether it would succeed in destroying America's productive power would depend in the main upon the organization and functional efficiency of the country's civil defense. This vital service has been a missing element in our system of national security.

Adequate civil defense will require the interest and effort of hundreds of thousands of our people, contributed for the most part on a voluntary basis, the report states.

These citizens will get little material return. Their interest and effort at this time, however, will be both wise and prudent, because until effective international control exists over the use of modern weapons which can devastate our towns and cities, we must put into action those precautionary measures which past experience and new tests have shown would save thousands of lives in case of attack.

Such a program is needed. It will be expensive. Budget details of cost are being worked out.

This report provides an outline of the organization and techniques which should be developed by the State and local communities on whom rest the primary responsibility for civil defense.

The plan presented here builds upon the wartime experience of Great Britain and Germany, as well as upon previous planning undertaken by agencies of the United States Government. In particular, it embraces material from the report entitled "Civil Defense for National Security" (Hopley Report) issued by the Department of Defense.

The plan recommends a basic civil defense law, the establishment of a Civil Defense Administration, and the appointment of an Administrator.

Typical of the subjects discussed in the booklet include the following: Application of defense planning, the role of the military in civil defense, air-raid-warning service, shelter protection, engineering service, communication, plant protection, and initial steps in civil-defense planning.

The 162-page booklet is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 25 cents per copy.

Electric-Drive Locomotives

THE locomotive of tomorrow is the electric locomotive, whether receiving its power from a trolley, a steam turbine, a Diesel engine, or a gas turbine, according to A. H. Candee, Mem. ASME, transportation engineer of the Westinghouse Electric Corporation, Pittsburgh, Pa. In a paper delivered before the Pan-American Railway Congress in Mexico City, Mexico, on October 10, 1950, Mr. Candee stated that propulsion of rail vehicles by electric motors has capabilities and advantages unsurpassed by any other form of drive. Among these advantages are smooth powerful acceleration; distribution of power to an unlimited number of driving axles; and relatively simple electrical equipment.

Mr. Candee pointed out that the modern reciprocating steam locomotive is approaching its practical limits for although horsepower capabilities may be built into the locomotive, wheel slippage limits the amount that can be used. To utilize more horsepower, there must be more weight per axle or more axles—but to build too many axles into a rigid frame lengthens the rigid wheel base beyond acceptable limits.

How to Obtain Further Information on "Briefing the Record" Items

MATERIAL for this section is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources, i.e.: (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

The initial steam-turbine locomotive was equipped with a gear transmission to provide motive power. The experiment was not too successful, since its mechanical drive limited the number of driving axles.

A major improvement in the steam-turbine locomotive was made in 1947 when Baldwin-Westinghouse designed a coal-burning steam-turbine-electric locomotive. In this locomotive, a single 6000-hp turbine drives generators that supply power to eight traction motors. Each motor in turn is geared to a driving axle. Three of these locomotives were built for use on the Chesapeake and Ohio Railway.

With the information gained through these locomotives a 4500-hp steam-turbine electric locomotive is now being built for the Norfolk and Western Railroad that will require only half as much coal as the conventional reciprocating steam locomotive. New developments in boiler and drafting design that minimize back pressure are responsible for the tremendous fuel savings. Diesel-electric performance has proved to be both reliable and economical. Built in sizes from 600 to 2400 hp, the Diesel-electric is rapidly replacing older locomotives in both yard and road work. Recently interest has been aroused in Diesel-electric rail cars, and it can be expected that the next few years will see a limited number of such applications.

A wartime development—the ignitron tube which converts alternating current into direct current—is also making its presence felt in railroad motive power. The ignitron makes possible the most desirable combination of a high-voltage a-c trolley system and heavy-duty d-c driving motors for electric railroads. (See "Ignitron Locomotive," in MECHANICAL ENGINEERING, September, 1950, page 740.)

Another new type of locomotive with wide commercial possibilities is the gas turbine with electric drive. Westinghouse has built and is now testing such a locomotive which operates on liquid fuel.

Airport Runways

ACCORDING to a paper read by Paul H. Stafford, chief, Airport Planning Division, Civil Aeronautics Administration, at the Conference on Ground Facilities for Air Transportation held at the Massachusetts Institute of Technology, recently, future airport design will call for runways with greater capacity or acceptance rate and more efficient operations in serving the increased volume of traffic. The requirements for runway directions have now been reduced to a minimum—one. This not only simplifies airport site selection, planning, and construction problems, states Mr. Stafford, but permits the use of more convenient sites and the expenditure of a greater portion of the available funds for building area facilities.

While it is realized that most locations will have a small percentage of the time when a single runway cannot be used by some types of aircraft due to cross-wind conditions, studies have shown that this percentage of time is generally much smaller than the percentage of time during which the airport is unusable by those aircraft due to other weather conditions. Mr. Stafford pointed out that the trend of aircraft design is definitely toward aircraft which are able to operate under practically any cross-wind conditions. It is concluded that it is better to provide more airports and better facilities of other types than to provide additional runways at all airports. The additional traffic which can operate into any airport by reason of multiple runway directions is not sufficient to justify the cost of constructing those runways.

The 6000 airports now in operation in the United States have sufficient traffic to justify only one runway. However, there are many which will require additional runways to handle peak traffic without unreasonable delay. Additional runways to handle a volume of traffic can be placed in several configurations. The simplest runway pattern is that of parallel runways adjacent to each other and separated by 500 to 1500 ft. This simple parallel configuration may frequently be used to advantage where light and heavy aircraft each constitute a substantial portion of the traffic. The inner runway, that is, the one closest to the building area, will normally be used by the lighter aircraft and may have less width, length, and strength. Traffic patterns for the two types of aircraft will normally be on opposite sides of the field adjacent to the runways to be used by each type.

This same simple parallel configuration can also be used where traffic is generally of the same type, with the inner runway normally being used for landings and the outer runway for take-offs, although both may be used for either purpose when traffic conditions warrant.

The next configuration is in the shape of the letter "H," with the building area lying between the two runways. To reduce taxiing distance it may be desirable to offset these runways, using the left runway for landings and the right for take-offs, unless topography prevents such arrangement. A separation of 3000 to 5000 ft between the parallel runways will normally be used in this design.

A runway configuration which has excellent traffic possibilities, according to Mr. Stafford, is the open "V," with the building area between the two runways and the wide end of the V oriented toward the prevailing wind. Landings can be accomplished on either runway while take-offs are in progress on the other without interference. Even under instrument conditions simultaneous use of the runways can be accomplished without present navigational equipment. This configuration has the added advantage that the take-off ends of the runway, under normal conditions, are close together and aircraft preparing for take-off can be directed to either runway, as traffic conditions permit. This configuration also allows two runway directions which will be advantageous under some strong wind conditions. Where conditions of topography do not permit either of the foregoing configurations, runways in the pattern of the letter "X" can be used to advantage where traffic control is exercised. Take-offs can frequently be made from a position adjacent to the terminal building and the interval between landing and take-off can be reduced by alternating the runways in use. While this configuration does not have the flexibility or capacity of the open V, it can handle considerably more traffic than a single runway.

Most of the airport program now consists in improvements to existing airports. In only a few instances do these improvements permit complete revision of the runway layout. It is therefore apparent that new criteria for runway configurations and the number of runways will not make revolutionary changes on our airport facilities. Instead, the change will be very gradual extending over a period of perhaps 10 to 20 years. This, emphasized Mr. Stafford, makes it highly important that we start now to design and build as best we can for aircraft which have not yet been placed on the drawing board.

Safe Flight Testing

AMERICAN test pilots—especially those who normally fly the dangerous, high-speed experimental planes—soon will have television as a flight-testing aid to remove much of the risk, according to the CADO *Technical Data Digest*, October, 1950.

The "X" planes of the future will still be subjected to the

same rigid tests they now undergo, but one or two video cameras will replace the man in the pilot's set to record all the instrument findings. Radio waves from the ground will control the dives and loops of the supersonic ships.

At present, engineers in both the Equipment Laboratory and the Electronics Subdivision at Air Materiel Command Headquarters are working closely with technicians of Lear, Incorporated of Grand Rapids, Mich., and the Philco Corporation of Philadelphia, Pa., to improve presently used TV for this purpose.

Lear engineers are developing the remote-control system which will enable a pilot and flight engineer on the ground to put the ship in the air through its paces just as if they were actually aboard, while Philco research men are working to make TV effective under severe flight-test conditions. Present remote-control systems used by the Navy and Air Force can duplicate many, but not all, of the maneuvers of a piloted aircraft.

Philco, Lear, and AMC engineers have not tried to test any high-speed planes like the X-1 and F-86 by television as yet, but two war-surplus craft, both of them F-24's (the old A-24 Douglas Dauntless, known to Navy pilots as the SBD), are being flight-tested with the new system. These tests indicate that the use of TV to replace test pilots on dangerous flights is entirely feasible, and the day when the X-6's or X-15's first flight is recorded by TV cameras is not too many months away.

However, it is emphasized that the Navy, Air Force, and company test pilot will not become a vanishing American. He will still be needed to handle the routine test flights. It is only on the dangerous tests which might cost a test pilot his life that television cameras will be used.

It is pointed out that all dangerous flights do not necessarily take place at high altitudes and speeds. It is almost as risky pushing a production-line plane like the B-50 beyond its speed or acceleration limit at 10,000 ft as it is to dive a supersonic plane at 1000 mph when you're 50,000 ft up.

Jeep Power Plant

A LIGHTWEIGHT, low-slung, extremely maneuverable three-wheeled Jeep is being produced by O. E. Szekely and Associates, Philadelphia, Pa., as a mobile power plant to energize U. S. Navy jet fighters as well as land-based military planes of various types.

This tricycle-geared Jeep is a self-propelled electric power plant capable of furnishing constant current (dc) for starting jet engines and constant-voltage direct current for starting reciprocating engines and for checking out the electric circuits of airplanes.

FIG. 1 TRICYCLE-GEARED JEEP FOR ENERGIZING JET AND CONVENTIONAL MILITARY AIRCRAFT

FIG. 2 TRICYCLE-GEARED JEEP IN ACTION ABOARD A U. S. NAVY AIRCRAFT CARRIER

The small, light, maneuverable three-wheeled Jeep power plants are used on aircraft carriers, while four-wheel, four-wheel-drive Jeeps are employed for energizing land-based planes.

The vehicle is under 36 in. high, approximately 19 in. lower than the standard Willys-Overland Jeep, less the windshield.

The Navy specified that the unit must not be more than 52 in. wide. It can turn a right-angle corner and it can execute a circle not exceeding 7 ft from the center to the outside wheel track.

The tricycle Jeep can also provide the ship's crew with auxiliary power for small hand tools and light.

The generator for the starting power and the auxiliary equipment gets its drive from the center power take-off of a converted Willys-Overland Jeep. It is installed on the opposite side of the transmisssion.

In addition to being lighter than its civilian counterpart, the three-wheeled Jeep is so low that it can easily pass under the wings of planes on carrier flight decks. This high degree of maneuverability enables it to move from plane to plane quickly and easily, and its generator cable need be only 15 ft long, half as long as that formerly required for the more conventional energizing units.

The entire unit, complete with special equipment, weighs only 1750 lb.

Underwater Camera

A COMPLETELY mobile underwater motion-picture camera, independent of air supply, and electric cables leading to the surface, has been developed by the Navy, it was disclosed by R. R. Conger, of the U. S. Naval Photographic Center, Anacostia, D. C., before a recent meeting of the Society of Motion Picture and Television Engineers.

Said to be the first of its kind, the camera, together with techniques for making the diver-photographer entirely independent of surface assistance, were developed for the Navy's program, now under way, to provide a series of training films for deep-sea divers.

The submarine motion-picture camera is designed, he explained, so that it can be completely operated from the outside, with external controls for the lens diaphragm, focus, and start-stop switch. It has detachable wings and vertical rudder which aid in transporting and stabilizing the camera under water, he stated.

The camera wings act as a planing surface, so that the diver-photographer can sight on his target through the viewfinder, kick his flippered feet, and guide himself by tilting and banking the camera similar to a plane in air. The underwater photographer is equipped with an "aqualung," an automatic, compressed air, self-contained diving unit, a "squale" face mask, and swim fins on his feet, according to Mr. Conger. Equipped in this fashion, the photographer is able to swim with the camera in any direction or to any depth down to approximately 200 ft.

The camera weighs about 107 lb in air, but can be adjusted to have either positive, negative, or neutral buoyancy under water. In time of danger, it can also be released to rise freely to the surface, he added.

Mr. Conger pointed out that applications of the underwater camera could be found in the motion-picture and television industries, where a new world could be brought to the screen. In the field of science, he added, pictures could be obtained which would permanently record the performance of ship hulls, the geological features of the sea bottom, and the characteristics and habits of plant and marine life.

Telescopic Gangways

THREE telescopic gangway units, said to be the first of their kind, are now in use for embarkation and disembarkation at the new ocean terminal of the Southern Region, British Railways, at Southampton, England, according to *Engineering*. The new-type gangways were designed and constructed by Structural and Mechanical Development Engineers, Ltd., of Slough, Buckinghamshire, England. The new terminal building is over 1200 ft long and three stories high, and the gangway installations provide links between the first floor and the vessel in the dock. The units are moved on rails along the quay to the correct positions opposite the ship's entry doors, and the extensible walkways, once in position, are entirely free, within the limits of the design, to follow movements of the ship caused by wind, tide, and loading. After use, the gangways are retracted and swung back parallel to the dock to leave a clear way for cargo cranes.

Each of the units has two telescopic walkways, one for outgoing and the other for ingoing traffic. The specification

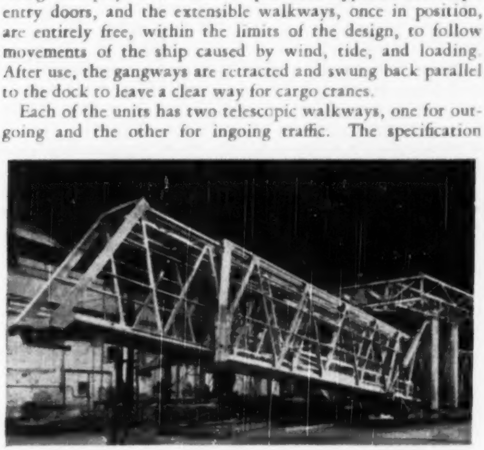


FIG. 3 INNER AND OUTER GANGWAYS OF TELESCOPIC UNIT SHOWING CONSTRUCTION BEFORE SHEETING

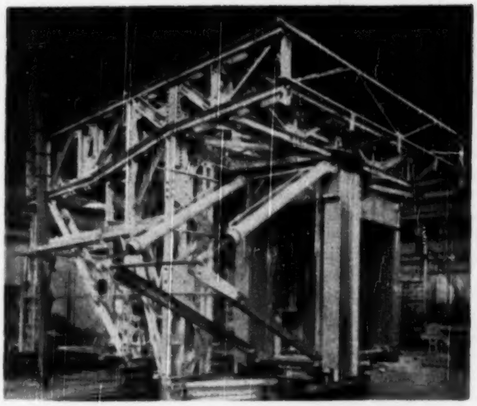


FIG. 4 SHORE STATION, SHOWING PAIR OF ROTATING TURRETS OF NEW TELESCOPIC GANGWAYS

called for a gangway with strength sufficient to withstand a vertical load of 200 lb per ft run and side winds up to 50 mph. To minimize the loads on the shore structure and reduce the size and weight of the operating mechanism, aluminum alloy was chosen as the structural material. The main members of the gangways are of box construction, formed from two aluminum extrusions supplied by the Southern Forge, Ltd., Langley, Buckinghamshire. The side frames are Warren girders and the floor is a sandwich construction of corrugated aluminum-alloy sheeting riveted to flat plates of the same material above and below. Each gangway is in two parts, the larger pivoted to a turret and supported by two hydraulic luffing rams, which are also attached to the turret. The other section of the gangway runs within the first on spring-loaded wheels, arranged in pairs, which bear on rails covered with a plastic strip. Extension and retraction are accomplished by driving the movable section by two endless roller chains which run on either side of the fixed section over sprocket wheels. The lower wheels are driven through gearing from an electric motor, and connection with the moving section is by means of two racks, mounted on the latter, which engage in the links of the chains. The loads on the chains are equalized and any slight skewing of the sections, such as might occur while the gangway was freely connected to the ship, is countered by giving each rack a 4-in. freedom of longitudinal position and by interconnecting the racks through a Lockheed hydraulic load-equalizing system.

Provision has been made for luffing the gangways in the vertical plane, by means of the rams, through a range extending from 20 deg below to 20 deg above horizontal. Slewing is accomplished by rotating the turret by means of two hydraulic rams, one on each side of the upper journal. These act simultaneously, one pushing and the other pulling on the box member which supports the journal, so that the force system reduces mainly to a couple. Two road wheels, on the turret side of the structure, run on a lower platform rail, and rollers, on the upper part of the structure at the rear, move along an upper rail. Between the two turrets is the control panel. The hydraulic pumping unit is mounted in the top of the structure at the rear.

To insure maximum safety in use, a system of interlocking controls has been provided. T-shaped anchors lock the mechanism to the slotted quay rail. Until the anchors are

secured, movement of the structure is restricted to travel along the quay in the retracted position. Once the anchors are made fast, travel along the quay is impossible, but power is available for maneuvering the gangways one at a time. Indicators show the amount of slewing and luffing and, by looking up the inside of the gangway, the operator can make the final fine adjustments necessary to guide the end of the gangway to rest on the threshold of the ship's door. A spring-loaded hook, mounted below the outer end of the gangway, engages with the side of the ship. As soon as this happens, the telescoping gear is automatically declutched, by the racks lifting out of the driving chains, and the oil pressure is by-passed, so that the gangway becomes instantaneously free to move with the ship. Alarms are provided to give warning and allow time for uncoupling, should the limits of the various movements of the gangway be approached while it is freely connected to the ship.

When the gangway is in use, the increased load causes the spring-loaded wheels on the movable section to lift and the load is distributed instead on pads fitted between each pair of wheels. When disengaging, only upward luffing is possible initially. As soon as the hook is free, the racks re-engage in the chains and the gangway must then be retracted fully before other movements are possible. It may then be swung round parallel to the quay. In case of failure of the electric supply, all the operations may be performed by hand winding or by the aid of a hand-operated hydraulic pump. The units are propelled along the quay by electric motors, which drive the road wheels through reduction gearing and are supplied through a trailing cable.

The principal dimensions and weights of the installation are as follows: Shore housing 26 ft long × 20 ft wide × 16 ft high; outer gangway 40 ft × 4 ft 6 in. × 8 ft; inner gangway 43 ft × 3 ft 9 in. × 7 ft 6 in.; total length of gangway, fully extended, 68 ft. The shore housing weighs 9 tons, the turrets 1 ton 5 cwt (2560 lb) each, and the outer and inner gangways 30 cwt (3360 lb) each. The total weight of each complete unit is $17^1/_2$ tons.

Nuclear Data

A VALUABLE tool for nuclear physicists and engineers, radiochemists, biophysicists, and other workers in the rapidly expanding field of nuclear physics is now available in the tables of "Nuclear Data" recently compiled by the National Bureau of Standards. These tables, which may be obtained from the Government Printing Office, are to be followed by supplements of new material at six-month intervals.

The initial volume of the tables, together with the supplements, will present a comprehensive collection of experimental values of half-lives, radiation energies, relative isotopic abundances, nuclear moments, and cross sections. Decay schemes and level diagrams, over 125 of which are included in the tables now ready, are to be provided wherever possible.

At present more than 1000 new measurements of different nuclear properties are being reported each year in some 30 different journals and in the reports of dozens of different laboratories. The reactor engineer and the industrial or medical user of radioactive tracer materials, as well as the nuclear physicist, are thus in need of a listing of available data which can automatically be kept up to date.

The National Bureau of Standards, with the assistance of the Oak Ridge National Laboratory, the Brookhaven National Laboratory, the Massachusetts Institute of Technology, and the University of California Radiation Laboratory, is making the first effort to present a continuing compilation in this rapidly developing field. The present tables and the supplements to follow are therefore designed for easy assimilation of new material in loose-leaf form.

All the more recent values of a given nuclear property are listed in the tables. Thus, from the degree of uniformity of the results, the reader can tell at a glance which nuclear constants now appear fairly certain and which are still quite doubtful. The references to over 2000 original papers make it possible for the research worker to evaluate the details of previous investigations and to design experiments to resolve existing discrepancies.

Circular 499, "Nuclear Data," 310 pages, is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. The price of $4.25 a copy includes the cost of three supplements (about 60 pages each) which the purchaser will automatically receive at six-month intervals. Remittances from foreign countries must be made in United States exchange and must include an additional sum of one third the publication price to cover mailing costs.

Low-Power Reactor

THE first controlled chain reaction producing atomic energy in the northeastern part of the United States was initiated near Schenectady, N. Y., two and a half years ago, it was revealed recently by Dr. Kenneth H. Kingdon, technical manager of the Knolls Atomic Power Laboratory, operated by the General Electric Company for the Atomic Energy Commission.

He said that the reaction was achieved at the Knolls Atomic Power Laboratory in a PPA, for "preliminary pile assembly," which has been in regular operation since that time. PPA's, also called "zero power" reactors because they operate at very low power for safety in the laboratory, make possible the quick testing of mock-ups of different reactor designs.

Such a reactor, or "pile," will not function unless a certain critical amount of uranium 235 or other fissionable material is brought together, said Dr. Kingdon. The Knolls PPA first attained this critical condition, and began to yield small amounts of power, on April 22, 1948. Since then it has been brought to "criticality" some 2000 times.

The staff of KAPL, organized in 1947, has been engaged in designing a plant for generation of large amounts of useful power from an atomic chain reaction. Originally, the main emphasis was one that could be used for peacetime industrial power and for the "breeding" of nuclear fuel. Earlier this year, on instructions from the AEC, this was suspended in favor of a power plant to be used on naval vessels. Such a shipboard plant will also yield valuable information for a land-based atomic power plant.

Dr. Kingdon explained that the PPA is primarily an experimental tool for testing those phases of reactor design which are not directly connected with the generation of large amounts of power. This has required that it be taken down and reassembled in eleven different combinations.

Although a commercial atomic power plant might produce many thousands of kilowatts, he explained, this PPA has been operated at powers of only a few watts. This limitation of power was necessary in order to restrict the radioactivity of the parts of the assembly to such low values that they could be handled manually with safety.

The fact that operation of the PPA has been entirely systematic and uneventful, Dr. Kingdon pointed out, shows once more the controllability and reliability of a properly designed nuclear reactor.

Summarizing the findings, he stated that the Knolls PPA has

proved to be a useful tool for securing accurate numerical data about atomic nuclei which are important in reactor design, both for the structural material and the nuclear fuel. The large amount of data obtained has formed the basis for some substantial advances in the theory of nuclear reactions.

As a result of these studies, great advances were made on the nuclear basis for a power-breeder reactor and several new ideas in design were developed. Particularly important and encouraging is the excellent agreement between calculations and experiment obtained with several of the assemblies.

Dr. Kingdon said that the Knolls PPA has also given the first demonstration of a new method for control of a nuclear reaction which is particularly adapted to reactors of this type. He stated that the method has worked very well and has now been carried to the point of testing a completely automatic control for a nuclear reactor.

Military Conveyers

THE belt conveyer is about ready to be used as a method of speeding up the flow of battlefield supplies, and the conveyer industry and the military should give serious study to incorporating the traditional mover of bulk materials into the military transportation setup, Harold Von Thaden, vice-president and general manager of the Robins Engineers Division of Hewitt-Robins Incorporated, New York, N. Y., told the Westinghouse Materials Handling Conference meeting at Buffalo, N. Y. He said that the belt conveyer had reached a stage of development where it could be utilized effectively to transport military supplies faster and in greater quantities than is now possible, and with a considerable saving in man power.

Pointing out that Korea has shown that we need not only more combat troops but more supplies as well at the front, Mr. Von Thaden proposed that "belt conveyers might supplement—and in some cases even supplant—other forms of military transportation. The conveyer would assure a greater and faster flow of supply and at the same time free Service Force troops for combat duty.

"Connect supply bases with a system of overland belt conveyers that will cut straight across the countryside. Further, the use of conveyers to transport supplies would release trucks for other uses and reduce traffic congestion on any roads that already exist," he said.

This supply conveyer, Mr. Von Thaden pointed out, would be (1) easier and quicker to build than a truck road, (2) simpler to operate, more economical, faster, and would carry greater loads than a fleet of trucks, and (3) would present less of a target than a truck-filled road, but in the event of a bombing could be repaired faster.

A 30-mile belt-conveyer system, manned by 100 soldier-technicians, would carry five tons of supply every minute at a continuous speed of five mph. To do the same job by vehicle, 400 trucks, manned by 1200 drivers, would have to be loaded at a rate of one a minute. Trucks might travel in convoy at an average speed of 30 mph, but because of terrain would probably have to travel over a distance of 45 miles to the conveyer's straight line of 30 miles, Mr. Von Thaden pointed out.

Using the estimate of seven men—six of them in supply and maintenance—required in the rear echelon to keep one man at the front, Mr. Von Thaden predicted, "with conveyers working in every place possible, we could cut down that ratio to five men in the rear area to one at the front."

In the current rearmament program, he noted, conveyers are playing an increasingly important part in the stockpiling of raw materials to keep industrial production at record high levels. Most vital part is in the acceleration of strategic ores—particularly iron ore from newly developed sources in South America, Liberia, and Labrador—to the nation's industrial plants. "One of the main factors in making this whole foreign ore operation practical is the imaginative use of the belt conveyer," Mr. Von Thaden said, "for only through the most modern and ingenious handling and transportation methods can this ore be brought economically to the nation's blast furnaces for conversion to steel for military supply.

"The program to supply our production lines with enough steel to build a defense stock pile appears about set and conveyers fit in as an integral part of this expanding plan, and the potentialities of conveyers in ore handling and processing, particularly in these overseas installations, are tremendous," Mr. Von Thaden said.

Hardwood Pulp

HARDWOODS are now becoming an important source for wood pulp, after decades of limited use, it is pointed out in the October, 1950, issue of the ***Industrial Bulletin*** of Arthur D. Little, Inc. Two high-yield processes are in use for making hardwood pulp, the article states, one new one makes "groundwood" for newsprint and other products, and the other, developed in 1926, is now being widely used for paper for shipping containers. Both processes combine aspects of the chemical and mechanical methods of making pulp.

The new groundwood process, called Chemigroundwood, was developed at the New York School of Forestry, in a program sponsored by a group of paper manufacturers, some of whom are now putting the process into commercial production. Whole logs are prepared for grinding with a six-hour treatment in hot neutral sulphite liquor. Initial vacuum, followed by the chemical under 200 lb pressure, aids penetration of the liquor into the wood. After this softening, it is ground to give a high yield of pulp. The fibers are more completely separated than in regular spruce groundwood, and there are no broken fiber bundles. It is said to bleach to a whiteness comparing favorably with ordinary bleached groundwood. Various mill tests indicate that the pulp can be used in newsprint, tissues, some book papers, and types of paperboard. Paper napkins from the pulp have been successfully tested in retail markets. Because of the high yield from hardboards, which are cheaper than spruce by the cord and also heavier, the production cost of pulp from the Chemigroundwood process is said to be about $40 a ton, or about two thirds the current price of spruce groundwood.

The older process, called "semichemical" and developed by the U. S. Forest Products Laboratory, has awaited mechanical adaptations and the right economic conditions to give the spark to expanded production. Several mills in hardwood areas have adopted the process. The logs are reduced to chips, which are digested with a relatively weak, low-cost cooking liquor. There are many modifications of the original formula for this liquor; a recent variation consists of merely soaking the chips in a solution of caustic soda at room temperature. The softened chips readily break down under mechanical treatment in water to the point where conventional paper-mill equipment can turn the product into paper. The pulp is only partially cooked or softened and contains much of the lignin and other noncellulose portions of the wood, thus increasing the yield. These processes have been used mostly in the manufacture of pulp for heavy boxboards and corrugated paper, where weight and stiffness are desirable and the color imparted by the lignin is not objectionable. Recent work has shown that semichemical pulps can be bleached for book, bond, tissue, and glassine papers.

Although this process was originally developed for hardwoods, it has also been extended to Southern yellow pine. For many uses the lower-cost long-fibered pulps produced by this method compare favorably with pulp made by the older and more costly sulphate or kraft process. Hardwoods were actually the first to be used when the demand for paper began to exceed the capacity of the rag paper processes brought over from Europe. As the easy-grinding poplar became scarce, however, and other hardwoods proved unsuitable, spruce became the chief source of groundwood, and yielded a pulp of high brightness, with good color and strength. The sulphite cooking process produced pulps with long strong fibers from the Northern conifers and the sulphate or kraft process, developed for Northern pines, was adapted to the Southern pines. Except for a limited use in book papers and other specialities, hardwood pulps have not been able to compete economically with softwood pulps made by the chemical processes.

Many softwood species do not reproduce themselves readily when cut, but frequently come back after cutting or fire to mixed hardwoods for the second growth. As stands of Northern spruce become depleted, and new sources are more remote from mills, costs rise—both U. S. and Canadian spruce groundwood pulp are now $65 a ton. The two processes now being put into use should go far toward utilizing the plentiful supplies of hardwoods now available in both the North and South.

Industrial Research Laboratory

SCIENTIFIC, industrial, and government leaders attended the 50th anniversary, on October 9, of the nation's first industrial research laboratory, the General Electric Research Laboratory. The observance was marked by the formal dedication of the laboratory's new home at the Knolls near Schenectady, N. Y.

Honored guests at the ceremonies dedicating the new buildings included Dr. Willis R. Whitney, founder of the laboratory in October, 1900, and its first director, and Dr. William D. Coolidge, x-ray pioneer and director-emeritus. Now 82, and honorary vice-president of General Electric, Dr. Whitney is still active in research. Dr. Coolidge (77) is x-ray consultant.

Also in attendance were members of the National Academy of Sciences, who held their autumn meeting at the laboratory.

DEDICATION ADDRESS

Charles E. Wilson, Mem. ASME, company president, in his dedication address reviewed the accomplishments of the laboratory in the past half century, and cited the necessity of industrial research to the nation's economy.

Mr. Wilson pointed to the fact that science today has progressed to a point where its findings are almost incomprehensible to the general public, yet these same findings are exerting a tremendous influence on the affairs of the ordinary man. He stressed the great cost of research, both government and private, but said that was a natural outgrowth of increased technology and awareness of the need for constant scientific research.

The G-E president said that industrial research laboratories recognize that their prime goal is supplying new scientific facts which can be rapidly translated into steadily increasing benefits to the entire nation. He pointed to such past developments from the G-E Research Laboratory as the gas-filled electric lamp, modern x-ray equipment, tubes which made possible effective radio broadcasting, and others, and declared that the future would see important developments in the field of metallurgy, electronics, chemistry, and many others.

Describing the role of large companies in research, Mr. Wilson said that "in an expanding economy and in a growing world there is a need for economic institutions of such sizes as are best adapted to cope with the ever-growing problems—scientific, technical, and economic—of that world." He declared that the primary explanation for any large company is that "it has a service to perform for the public."

RESEARCH LABORATORY

The laboratory itself, which is devoted primarily to fundamental research, has a staff of more than 800. For example, on the third floor, which is at entrance level scientists are engaged in metallurgical research into some of the fundamental facts about metals, seeking to determine just why they behave as they do. To aid the scientists there are small furnaces for preparing experimental quantities of new alloys, light microscopes, and an electron microscope for highly magnified views of metallic and other structures, equipment utilizing electrons as well as x rays to determine the crystal structure of metals.

The fourth and fifth floors of one of the wings house the Chemistry Division. The chemists are engaged in many kinds of researches, some concerned with combustion studies, others with new kinds of plastics. Since work in chemistry often creates unpleasant or even toxic fumes, these rooms are particularly well ventilated. Each chemist has, in addition to his regular open working space, a hood where he can perform experiments making such noxious vapors. These hoods are exhausted by ducts leading to a battery of blowers in a "monitor," a special long structure above the fifth floor, and then through the roof to the open air. The central wing of the fourth floor is devoted to electronics research, including the development of high-power tubes for the production of short radio waves. Other electronic research, much of it concerned with television, is conducted on the fifth floor of this wing. Here also is the headquarters of the group of scientists engaged in meteorological research, under the U. S. government's "Project Cirrus" which has led to the development of methods of possible weather control.

On the second floor of the building there are research rooms

FIG. 5 SCIENTISTS AT WORK ON 300,000,000-VOLT SYNCHROTRON NOW UNDER CONSTRUCTION IN THE GENERAL ELECTRIC RESEARCH LABORATORY

FIG. 6 CLUES TO CRYSTAL STRUCTURE, LEADING IN TURN TO DEVELOPMENT OF MATERIALS WITH PROPERTIES NEEDED FOR SPECIFIC JOBS, ARE REVEALED BY THIS G-E RESEARCH LABORATORY DEVICE CALLED THE X-RAY SPECTROGONIOMETER

for the division of mechanical investigations, devoted to the studies of rockets, combustion, refrigeration, vibration, etc. Another division, which is studying various aspects of ceramics, is on another part of the floor. On the first floor is a research group concerned with problems of optics.

The major parts of the first and second floors, however, contain the various laboratory shops, fully equipped and manned to construct quickly special equipment needed by the scientists in their researches. There is a large machine shop, a woodworking shop, a glass-blowing shop, a welding shop, and electrical shop as well as a small but well-equipped foundry for experimental work with metals, and various types of metal-testing machines.

In addition to the main laboratory building there are a number of others on the 180-acre tract. To the east is the Radiation Laboratory, in which a new type of atom smasher, known as the "nonferromagnetic synchrotron," which is expected to yield 300,000,000-volt x rays for atomic research, is nearing completion. This building also houses a smaller, 80,000,000-volt synchrotron, and x-ray equipment for one, two, and ten-million-volt radiation.

At a lower level, nearer the Mohawk River, is the plant providing steam for the laboratory, a chemical pilot plant, and a low-temperature laboratory. The pilot plant is built so that new chemical processes may be tried out on a scale larger than the test-tube operations that would be performed in the laboratory rooms. The low-temperature laboratory is equipped to produce liquid helium, the coldest substance known to man, which boils at 452 deg below zero F. This can be used to produce still lower temperatures, closely approaching the absolute zero of 460 deg below zero F. The laboratory will not only produce these temperatures but will also study the curious effects that occur at such intense cold. One, of great interest, is that some metals lose all electrical resistance near absolute zero.

European versus American Research

In the evening members of the NAS were guests of the General Electric Company at a reception and dinner held in the Research Laboratory. This was followed by an address by Dr. Paul Scherrer, professor of physics at the Institute of Technology of Zürich, Switzerland.

Discussing aspects of contemporary research in Europe and America, Dr. Scherrer said that the historical development of the various countries of Europe makes them competitive rather than co-operative, and that this seems to prevent their getting together on large scientific projects such as building huge atom smashers and highly complex computing machines.

It has been proposed at several UNESCO meetings by both European and American physicists, he said, that the various countries of Europe should unite in a common effort and build one large center of atomic research. However, he added, at one meeting held in Amsterdam to discuss such a project, they could not agree on just what should be included in the center. Another suggestion, he said, was for a large European center for nuclear studies at Paris.

"This project was discussed very seriously," he stated, "but the fear of all the physicists was that if their own governments had to spend so much for such an international center, no money would be left for the physical institutes at home."

He pointed out that an important difference between Europe and the U.S.A. is the popularity of science here.

"Science is extremely popular in the eyes of the American public," he said. "The American people are well aware of the great achievements of science and the fame of science is carefully supported by the press. Edison is a hero for the American, but nobody in Europe looks on Faraday or on Marconi as a hero.

"However," he continued, "I believe that we do not have to be pessimistic in Europe, in so far as pure science is concerned. Surely we do not have the facilities for this teamwork you have here. We do not have your 'dream laboratories,' so we must learn to work in a different way.

"We cannot push forward the big front, which separates the known from the unknown. That would need too many scientists working simultaneously. We can just try to push for-

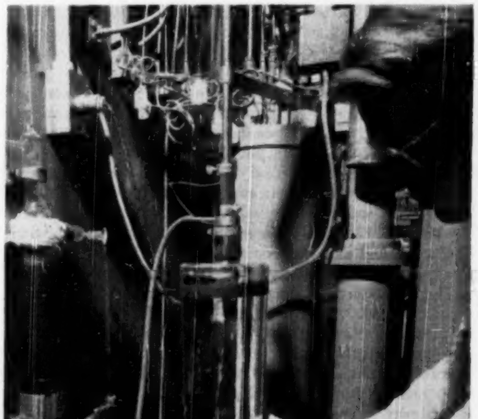


FIG. 7 COLDEST SUBSTANCE KNOWN TO MAN—LIQUID HELIUM AT A TEMPERATURE OF 452 DEG BELOW ZERO F—IS PRODUCED HERE IN THE BUSINESS END OF THE LIQUEFACTION PLANT OF THE G-E RESEARCH LABORATORY'S LOW-TEMPERATURE LABORATORY

ward very fine and thin needles into the wide zone of the unknown, and we can look very carefully for new and proper problems, for new fields which can be handled by such research.

"There are lots of them. There is so much that is not well or even not at all understood; so many old problems are still without an answer. The field of science is still vast, it is infinite."

As an example of one of these problems, he cited that of the "zero point energy of radiation." According to the quantum theory, he explained, enormous amounts of energy—nearly a million times as much as the atomic energy available in uranium—exist throughout space.

In all "empty" space, like that between the stars and planets, even at absolute zero of temperature (minus 460 F), he explained, a large amount of energy is present in the form of light waves and other electromagnetic radiations which are passing through in all directions. From theoretical considerations one can calculate the amount.

In terms of mass, making use of Einstein's famous formula for the equivalence of mass and energy, it is of the order of one kilogram of energy per cubic centimeter of space, equal to about 30 tons per cu ft. Expressed in the more familiar units by which electrical energy is purchased from the power company, it would be some 700 million million kwhr per cu ft.

"The theoretical physicist needs this zero point radiation to explain the behavior of radiating atoms," said Dr. Scherrer. "If it really exists, it should, by its mass alone, produce enormous gravitational effects. The fact that we have not been able to detect such effects shows that our theories are inadequate.

"This is just such a new problem to think about," he added. "It would be fine if someday we could use a bit of this energy, which we must admit today is absolutely frozen and unavailable to the physicist."

Coal Research

THE coal industry's plans for its 1951 co-operatively financed research program to develop improved coal-burning equipment and methods have been announced recently by Bituminous Coal Research, Inc.

BCR, the bituminous coal industry's co-operative research agency, which receives its support from 300 of the nation's leading coal and railroad companies, has announced a program for next year that will develop more efficient coal-burning equipment and will seek basic information about coal that can be applied in future coal equipment and process developments.

The BCR Board of Directors has authorized an expenditure of more than $400,000 for carrying out BCR research, exclusive of its program to develop the coal-burning gas-turbine locomotive and improved mining equipment and methods. In addition, other industries and associations will add more than $200,000 in support of projects to which the coal industry is a major contributor through BCR.

As a result of this research, a smokeless magazine-feed heating stove, more convenient and efficient than conventional units, is being commercially manufactured. Smokeless-magazine-feed warm-air furnaces and heating boilers are undergoing user tests prior to commercialization. A new type of completely automatic stoker with bin feeding and mechanical ash removal is under development.

BCR will continue its research leading to the improvement of the steam locomotive. It will carry on as a major financial and technical contributor to the Allegheny County, Pa., railroads' project to reduce cinder emission, and will continue its studies on steam-locomotive combustion.

In addition to its combustion and equipment research that is helping industry to use coal more efficiently, BCR will give major attention next year to evaluating the technical and economic aspects of block heating in business districts, and will appraise the feasibility of increasing the use of electric furnaces in steelmaking.

BCR last year helped the operators of small industrial plants by showing them how to capitalize on the use of coal by better operating procedures and equipment. Further help will be provided to the small-plant owner by a project that will make information about cinder collection available.

Results of BCR research have been an important factor in the abatement of industrial smoke. BCR has been largely responsible for the development and application of modern overfire jets which have made it possible for industrial chimneys to be smokeless. In order to satisfy the public demand for air-pollution abatement, many of BCR's projects have smokeless operation as a basic requirement in the coal-burning equipment and processes it develops.

The bituminous-coal industry's research agency during the current year completed a survey of the technical and economic factors affecting the manufacture of fuel gas from coal. As a result of that survey BCR is engaged with others in a project to develop an improved automatic gas producer, capable of high gasification rates. Such gas producers, located at the point of gas consumption would give industrial plants an uninterrupted gas supply under their own control. BCR will continue, also, its work to develop new knowledge in the field of gasification and carbonization.

Fundamental research will continue on the causes and prevention of acid mine water.

Rubber

RESEARCH and development in the last 10 years have lengthened the service life of both crude and man-made rubbers so that today practically all industrial rubber products are made to higher specifications and wear longer than those manufactured a decade ago.

So declares W. L. Smith, technical superintendent, Industrial Products Division of The B. F. Goodrich Company, pointing out that one of the reasons the nation will not have as much trouble creating a satisfactory rubber stock pile as it did previously, is that pound for pound the material gives more service. This is fortunate, he said, because annual rubber consumption of the U. S. now exceeds a million tons compared with 650,000 in 1940.

Today, for example, some conveyer belts outclass their 1940 counterparts by as much as 60 per cent on tonnage carried. Ten years ago large coal-mining companies expected conveyer belts to carry 25,000,000 tons of coal on certain installations. On such jobs today, belts have a potential of 40,000,000 tons carried. Belts being produced now for conveying hot materials carry 40 per cent greater tonnage within the belt life than belts in the same category carried only 10 years ago. Conservative estimates indicate a 100 per cent improvement in the service life of oil-resisting conveyer belts during the past decade.

He pointed out that one patented feature, resulting in the grommet multi-V belt, has improved the V-belt life by 40 per cent. Today's automotive fan belts are 130 per cent longer-lived than the 1940 product.

He said that longer belt life has resulted from new, stronger fabrics, cord and fibers used to make the strengthening carcass belts, and the introduction of steel cable-cord reinforcement. These developments permit longer belts and higher lift, in the case of conveyer belts.

Mr. Smith pointed to recent advances made in manufacturing and compounding man-made rubber "tailored" for particular jobs. The use of such tailored compounds in hose tubes and covers, combined with new improved carbon blacks, has increased hose life in some cases by 500 per cent in a ten-year period. Such improvements are recorded for many types of oil hose due to improved resistance of the hose tube to oil. Cover improvements include resistance to abrasion and cutting, sunlight, heat, weathering, oil, and acids.

An example of how an improved cover can lengthen hose life is evident in a new steam hose cover developed by Mr. Smith's company. On jobs where heat deteriorates hose covers, the new cover has been known to increase hose life by 1000 per cent.

The advent of synthetic textile fibers has resulted in hose with greater strength and lighter weight, according to Mr. Smith. Weight of oil-suction and discharge hose has been reduced about 50 per cent in the past decade by these means. A synthetic yarn in one fire hose yields jackets 12 per cent lighter with 50 per cent greater strength. One hose for small air tools is 50 per cent lighter than other hose of the same working pressure.

He warned that the average user of industrial products was the one big question mark which might upset the trend toward more effective use of available rubber supplies. He urged that plant superintendents and foremen be doubly certain that rubber products important to their own production receive proper care and maintenance. Such attention, Mr. Smith said, will conserve rubber by adding years of service to industrial rubber products now in use.

Steel Production

BY the end of 1952 steel companies in the United States will be able to produce 22 per cent more steel annually than was made in the peak year of World War II. This is predicted in the October, 1950, issue of *Steel Facts*.

The companies, it is stated, will expand and improve their steelmaking facilities, and will raise their total annual capacity 9.4 million tons in the period between July 1, 1950, and the end of 1952. At the latter date, the total annual capacity of steelmaking furnaces will be 109,963,000 tons.

The companies' plans to go far beyond their present large capacity totaling about 100.5 million tons, were disclosed in a recent survey by the American Iron and Steel Institute. The survey supersedes a similar study as of July 1, 1950.

The dominance of the United States among the steelmaking nations of the world will be extended by these expansion and improvement programs, which are the greatest in the history of the steel industry. Producing at full capacity at the end of 1952, the United States' annual production will account for about 55 per cent of the world output, if other nations continue to make as much steel as they did last year.

In order to operate 109,963,000 tons of capacity fully, vast tonnages of iron ore will be needed annually for blast furnaces and steelmaking furnaces. Well over 100 million tons of coal will be required. The required amount of scrap, fuel oil, and natural gas will be considerably larger than at present.

In order to line up the huge supplies of raw materials, much long-range planning has been and is being done. New sources of supply for manganese and other materials have been found. Iron-ore reserves have been lined up in Quebec, Labrador, South America, and Liberia, while research has been expedited toward the economical use of taconites and low-grade ores abounding in the Lake Superior regions.

Progress is being made toward the use of taconites. Larger amounts of pellets are being used experimentally in blast furnaces. The development of a special jet piercing drill, which pierces holes in taconite deposits, promises to hasten the task of mining.

Other long-range planning has been centered upon the need for ore vessels, dock facilities, and the land required for new plants.

According to *Steel Facts*, steelmaking furnaces this year may pour about 96,500,000 tons of steel, a record amount, if the rate of production in recent months isn't interrupted by unforeseen circumstances.

The 1950 output of steel will be almost 7 million tons higher than the best production during the peak year of World War II. It will be almost 19 million tons greater than the total for 1949.

The industry's new record high capacity of more than 100.5 million tons is greatly aiding the production drive.

From January to August more steel was made this year than has ever before been produced in an eight-month period.

More than 63 million tons of ingots and steel for castings was the record output of the eight months. That exceeded the entire production of any full year prior to 1940. It was almost three times the estimated output of Russia in all of 1949.

At the high rate of production, only two thirds of a month would be required to make all the finished steel which Washington officials have estimated to be needed for the Korean war. Their estimates indicated requirements of about 4 million tons.

Thus, with larger capacities than ever before, steel companies are confident that they can meet the emergencies of the future, barring the effect of strikes or other unforeseen setbacks.

Meanwhile, the production of four major kinds of durable consumer goods has been exceeding all past records this year. Other types of consumer products are coming very close to their highest production levels. The four leaders are dwellings, automobiles, refrigerators, and television sets. The automobile industry by the middle of October turned out as many cars and trucks as in all of 1949 when it set a record of 6.2 million units. The trend in housing is similar, with 839,000 units started in seven months, 54 per cent more than a year earlier. The output of cooking stoves, washing machines, vacuum cleaners, and other appliances has been running close to records made in 1947 and 1948.

In the first six months of 1950, before the start of the Korean war, the amount of steel shipped to customers of the steel industry established a half-year record at nearly 34.6 million tons, largely because of the record high demand for automobiles, housing, oil and gas appliances, electrical equipment, and containers.

Electromagnetic Devices

GRAPHITE is a lubricant and widely used in many forms to eliminate friction. Yet, dry graphite powder is employed to produce friction without wear in the electromagnetic clutches and brakes being produced by Eaton Manufacturing Company, Cleveland, Ohio.

The following advantages are claimed for these electromagnetic clutches and brakes: Insignificant wear, freedom from drag, no serious sealing problems, simple remote control, instantaneous response to control current, torsional vibrations can be absorbed, modulation and accurately repeatable response in accordance with excitation, negligible amount of input control current compared with output power, automatic simple control of output speed or torque, straight-line torque

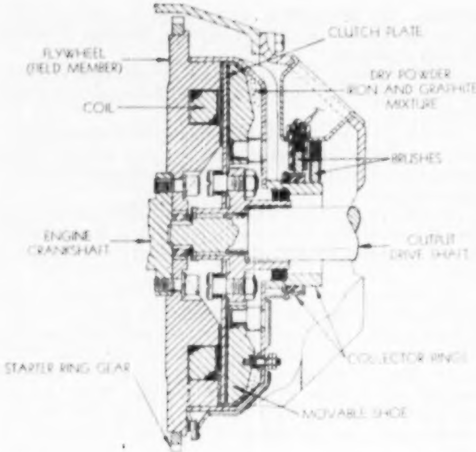


FIG. 8 TYPICAL AIR-GAP TYPE ELECTROMAGNETIC CLUTCH FOR AUTOMOTIVE USE

characteristics obtained without chatter or other objectionable qualities, and constant or variable speed and torque output from constant or variable input speed.

These electromagnetic clutches and brakes have applications extending into many fields, such as automotive and aircraft; paper, textiles, wire, etc.; machine tools; marine propulsion; and home appliances such as washing machines, sewing machines, power mowers, and garden tractors.

There are two basic designs of electromagnetic devices, common to each of which is a magnet coil and complete magnetic circuit. One type maintains a fixed air gap between the rotating members into which iron and graphite particles are drawn magnetically when the current is applied. The other type has a variable air gap and is similar to a disk-plate clutch in which the iron and graphite particles are magnetically drawn between the plates as they are magnetically closed, thereby renewing the "friction linings" each time the current is applied.

In the type with fixed air gap, when the magnet coil is excited, the powdered iron-graphite mixture is drawn into the fixed space separating the drum and electromagnetic field, where it is literally "frozen" between these surfaces. This provides a lubricated load-transmitting bond, the strength of which depends upon the value of the exciting current applied to the magnet coil. By varying the exciting current, any condition of slip from full lock-up to full release can be obtained. When the coil is de-energized, the magnetic and lubricating particles composing the bond immediately collapse and the members rotate freely with no viscous drag or creep induced by the mixture. This is due to the lightness of the mixture which allows it to circulate freely in the air gap. This fixed air-gap type is usually more desirable for constant slipping, modulating, or retarder applications.

In the variable air-gap type one or more plates are clamped between the field member containing the coil and the shoe which completes the magnetic circuit. When the coil is excited, the shoe is drawn magnetically toward the field, thus squeezing the plate or plates between the field member and the shoe. As this occurs, particles of powdered iron and graphite are trapped on the friction surfaces, thereby automatically refacing them each time the current is applied. The variable air-gap type is recommended where smooth clutching or braking engagement and action are required with maximum capacity in minimum space.

Reports indicate that exhaustive tests and many field installations have demonstrated the extremely long life of these electromagnetic devices. Usually they have actually improved with use and mechanical wear has not been detectable.

A typical case history is that of a fixed air-gap type. This unit, driven by a 5-hp motor at an input speed of 3100 rpm, was first operated on life test in the laboratory, cycling once a minute, for 1032 hr. Then, without disassembly for inspection, it was installed as the cooling fan of a city-delivery car. After nine months of operation (and still performing perfectly), the clutch was removed for test and examination. Dynamometer tests revealed no change in performance characteristics and all parts were found to be in perfect condition. No sign of wear or weakness of any kind was apparant. This specific example is only one of many test models which have been operating satisfactorily for long periods of time in various types of service and widely different applications.

Oil Pipe Lines

BOTH the mileage and the cubic capacity of the nation's network of pipe lines for moving petroleum and its products have increased greatly since 1941, Secretary of the Interior Oscar L. Chapman said, recently.

Citing a Bureau of Mines survey just published, Secretary Chapman pointed out that between May 1, 1941, date of the last previous survey, and January 1, 1950, this country's petroleum and petroleum products pipe-line system increased 25,463 miles to a total length of 152,814 miles. The mileage added to the nation's pipe-line network in nine years would circle the earth at the equator, with 560 miles to spare, it was pointed out. Total oil pipe-line mileage as of last January 1 was equivalent to more than two thirds of this country's total railroad mileage. The "Big Inch" and "Little Inch" lines, built during World War II at Government expense, do not figure in this increase, since they were sold and converted to natural-gas service in December, 1946.

The records of the 24-in. Big Inch and the 20-in. Little Inch, which respectively moved more than 300,000 bbl of crude oil and more than 230,000 bbl of gasoline and light oil a day, demonstrated to the industry the economy of large-diameter pipe lines for long-distance oil movement, the report says. Noting the increase in the average diameter of crude-oil trunk lines between surveys from 8.4 to 9.8 in., the report adds that the major oil pipe-line projects built since V-J Day have used large-diameter pipe.

Between Bureau of Mines surveys, the total length of crude-oil trunk lines 10 in. or more in diameter increased 8748 miles, while that of smaller-diameter lines decreased 2555 miles for a net gain of 6193 miles. The largest increase was observed in lines 10 in. or more in diameter, the average size of this group being 20 in. Texas gained more crude-oil trunk-line mileage than any other state—3539 miles—and Kansas suffered the greatest loss of such mileage—918 miles.

An increase of 11,880 miles in refined-product trunk lines more than doubled their mileage, the report notes. It observes that such lines are operating in 35 states and the District of Columbia, and that a new one was being extended into the Pacific Northwest at the time the survey was taken.

The report includes tables breaking down pipe-line mileage by states, by diameter of pipe, and by products handled, presenting these data separately for trunk lines and gathering lines.

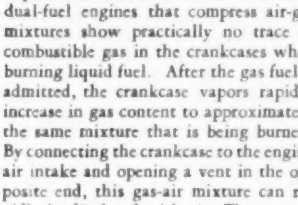
ASME TECHNICAL DIGEST

Substance in Brief of Papers Presented at ASME Meetings

Petroleum Mechanical Engineering

Crankcase Explosions, by F. V. Cook, Mem. ASME, Service Pipe Line Company, Tulsa, Okla. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-1** (mimeographed).

ACCORDING to the paper, crankcase explosions result from ignited mixtures of vapor and air that fill the spaces between the droplets of oily mist in crankcases; piston blow-by is negligible except during the compression stroke. These are the conclusions resulting from many tests of Diesel, gas, and dual-fuel-engine crankcases that were made by drawing the contents of the crankcase from a shielded area to avoid including drops of lubricating oil. All natural-gas engines, the crankcases of which were vented only to the atmosphere were found to contain explosive mixtures. Diesel engines contained little or no explosive vapors even when not vented. Unvented dual-fuel engines that compress air-gas mixtures show practically no trace of combustible gas in the crankcases when burning liquid fuel. After the gas fuel is admitted, the crankcase vapors rapidly increase in gas content to approximately the same mixture that is being burned. By connecting the crankcase to the engine air intake and opening a vent in the opposite end, this gas-air mixture can rapidly be displaced with air. These tests, performed many times, can lead only to the conclusion that there is sufficient blow-by on the compression stroke of every engine to place in the crankcase the same mixture that is being compressed by the piston. No appreciable quantities of carbon monoxide or carbon dioxide have been found in the crankcases of Diesel or gas engines even when the piston rings were in poor condition.



CRANKCASE EXPLOSION RELIEF VALVE

The following preventive measures are suggested: (1) Maintain a nonexplosive mixture in the crankcase; (2) provide means of drenching the crankcase with carbon dioxide when trouble occurs; (3) strengthen the crankcase to withstand an explosion; (4) remove from the crankcase, in so far as possible, all sources of hot surfaces; and (5) realize that explosions are unavoidable and provide a sufficient quantity of explosion valves to relieve the pressure without damage to property or personnel and to prevent the fire that often follows crankcase explosions.

Pipe-Line Compressor Lubrication and Maintenance, by O. H. Moore, Tennessee Gas Transmission Company, Houston, Texas. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-3** (mimeographed).

THE maintenance of lubricating oils in the gas-engine compressor is receiving more attention from the operator, the lubricating engineer, and the manufacturer of reconditioning equipment than ever before. As a result, many of the lubricating problems are being solved by the exchange of operating data from plant to plant and between gas companies. The oil companies are sending lubricating engineers into the field on routine schedule to assist in a more efficient performance of their lubricating oils. These engineers have an opportunity of seeing their oils in use under varying conditions and can often go directly to the trouble, thereby assisting the operator immensely.

Due to Tennessee's plants being so widely separated, written reports are heavily relied upon. Each oil-supply company sends a lubricating engineer into its respective plants on routine schedule to pick up oil samples and to discuss analysis of previous samples with the

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operators. These samples are sent in to the laboratory for analysis, and copies of the results are sent to the station and to the Houston office. A general set of recommendations is prepared on all samples reported on, with these recommendations being sent to the Houston office.

The company has followed the practice of trying to maintain the crankcase oils in as new condition as possible. Many of the plants are still using the initial charge of oil. Additional oil, of course, has had to be added to the crankcases, but there hasn't been a general changing of oil. This period of operation is of course short in comparison to other gas companies and other batches of oil, as the operation covers only a period of five years to date.

A Review of the Factors to Be Considered in the Selection and Maintenance of Diesel-Engine Lubricating Oils, by E. B. Rawlins, The Cooper-Bessemer Corporation, Mount Vernon, Ohio. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-12** (mimeographed).

INFORMATION relative to the properties of different types of lubricating oils is presented so that selection of Diesel-engine lubricants can be made with reasonable assurance of predicting the performance of the oil selected.

The various crudes and their refining methods, blending and compounding, engine type, service, condition and maintenance, lubricating-oil type, operating temperature, filtration and maintenance, and kind of fuel used, are all factors that must be considered in making this selection.

In the interest of improved Diesel performance, reduced maintenance costs, and long engine life, the following suggestions are made: (1) Use only those oils that are fortified to combat the heat and deposits common to all Diesel engines; (2) select oils that will keep your engine clean such as detergent oils; (3) select oils with a high viscosity index for low oil consumption and greater stability, or if the characteristics of the naphthenic base oils are indicated, select the highest-viscosity-index oils that the naphthenic base stock will provide; (4) select oils compounded of high-grade stocks and low carbon content; (5) select oils of the proper viscosity for Diesel-engine service—SAE-40 oils have been found to be, generally, the most satisfactory for heavy duty service; (6) select oils in the Supplement 1 or Supplement 2 class for engines using high-sulphur fuels or making an excessive amount of dirt; (7) select oils of heavier viscosities, high viscosity index, higher additive concentration, and highest quality for high-output engines—the higher heats and heavier loads require oils with heavier body and greater fortification; (8) increase operating temperatures, thereby giving the detergents an opportunity to operate efficiently and reducing the chance of contamination by water condensate—a temperature of 170 to 190 F is regarded safe for modern lubricating oils; (9) provide adequate filtering for the oil—full flow filtering is the best but a well-designed bleeder or by-pass filter system will provide good filtering; (10) use only the oil selected, do not mix with other oils, and be sure that it fits the engine and service—take care of it, and good performance and long life can be expected.

Lubrication of Refinery Equipment, by Frank M. Leverett, Mem. ASME, The Texas Company, Port Arthur, Texas. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-13** (mimeographed).

THE equipment requiring lubrication in a large refinery ranges from such delicate mechanisms as instruments for indicating and recording pressures, temperatures, rates of flow, etc., to that of steam locomotives, large turbogenerators, earth-moving equipment, etc., and includes such machinery as pumps, compressors, blowers, steam engines, gas engines, steam turbines, cranes, elevators, conveyers, automotive equipment, machine-shop equipment, and the like.

Careful attention is given whenever refinery equipment is put into operation, to the recommendations of the manufacturer of that equipment for its lubrication. These recommendations in so far as they cover the kind of lubricant desired, its viscosity or consistency, frequency and amount of lubricant used, and method of application are strictly adhered to. It is, of course, one of the important functions of a manufacturer of lubricants to work closely with all manufacturers to the end that the lubricants furnished and recommendations for lubrication made are not only adequate and satisfactory in the equipment but also acceptable and approved by the manufacturer. Many occasions arise whereby it is not possible to make a satisfactory recommendation for lubrication until the full operating conditions have been determined, so that the lubricant instructions of the manufacturer must of necessity be very general, or for average conditions. These general instructions should then be used as a guide to the final selection.

Refinery Lubrication—A Management Problem, by L. F. Jahnke, Socony-Vacuum Oil Company, Inc., New York, N. Y. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-7** (mimeographed).

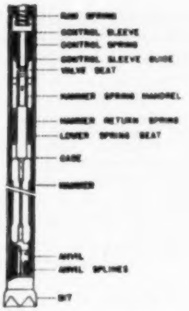
TO stay competitive in costs, a refinery management cannot stop with the solution of major problems; it must also give attention to numerous lesser items. Lubrication is one of these on which the solution is not always obvious.

To aid in an analysis of this problem, ten significant factors are listed. It is suggested that a check of these ten points against current operating practice will permit any refinery management to weigh their present lubrication efficiency and estimate the possible savings of better practices. A pattern for an orderly attack on the problem is then presented.

The ten preliminary checks are as follows: (1) Do you have the smallest practical number of different lubricants in use? (2) Do you use the minimum amount of grease and oil? (3) Are the right lubricants in use at every point? (4) Do you find posted charts of recommended lubricants and practices? (5) Is there a system of adequate education of all those who have any responsibility for lubrication? (6) Is there a well-organized central storehouse of lubricants together with good local storage facilities? (7) Are there well-planned records of consumption, application, and oil changes? (8) Are dirt and contamination prevented from entering lubricants and bearings? (9) Are there few or no evidences of wear and trouble resulting from faulty lubrication? (10) Is there a soundly organized plan for control of lubrication?

The Bassinger Rotary Percussion Drill, by Robinson Brown, Southwest Research Institute, San Antonio, Texas. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-15** (mimeographed).

THE need for a tool which would add to rotary drilling equipment a cable tool or percussive action has been recognized for a long time. It is well known that the hammering action of cable tools holds an advantage over a straight rotary action in the very hard and friable formations. The natural trend of thought of men acquainted with both types of drilling has been to combine the percussive action of cable tools with rotary equipment, thus retaining the inherent advantages of continuous rotation and fluid circulation and adding the impact action of cable tools. This paper presents some of the history of rotary-percussion development, a discus-



LATEST TYPE OF BASSINGER DRILL

sion of the Bassinger drill, and a comparison of results obtained with this drill against conventional rotary drilling.

The latest development of the Bassinger drill is one in which the strokes per minute have been increased from an average of 225 to an average of 800.

The essential parts are a ram spring, control sleeve, control spring, control-sleeve guide, valve seat, hammer spring mandrel, hammer return spring, lower spring seat, case, hammer, anvil, anvil splines, and bit.

In operation when cirdulation is started, the control sleeve, which had been in its uppermost position with its top resting on the lower face of the ram spring, is forced down carrying the hammer down with it. When the control sleeve reaches its stop in the control-sleeve guide, its downward movement is arrested and the hammer continues down, opening the valve and allowing exhaust of the drilling fluid. As soon as exhaust begins, the control sleeve returns to its uppermost position against the ram spring; and the hammer rebounds off the anvil, which rebound, plus the force of the hammer return spring, accelerates the hammer upward to again seat the valve. When the valve seats in the lower end of the control sleeve, overtravel is provided for, in that the ram spring will be compressed. This compression of the ram spring serves not only to provide for overtravel but also to store energy which is recovered in the form of increased hammer velocity on the next stroke.

This new design includes a central opening through the hammer and spring mandrel, thus allowing fluid passage through these parts as well as around them to reduce resistance to travel of the hammer through the fluid. This change, plus the addition of a ram spring and the seating of the upper end of the spring mandrel on the lower end of the control sleeve, accounts for the increased cycling rate herein mentioned.

Instruments for Pipe-Line Pressure-Surge Studies, by F. O. Stivers, Jun. ASME, Humble Pipe Line Company, Houston, Texas. 1950 ASME Petroleum Mechanical Engineering Conference paper No. 50—**PET-2** (mimeographed).

BECAUSE of the shortcomings of mechanical gages, most pipe-line surge-pressure studies now being undertaken are using electrical instruments of some kind.

The most common type of instrumentation for measuring transient pressures usually consists of two primary units; first, is the pickup or transmitter which converts a pressure change into some measurable electrical variable such as resistance, potential, or capacitance and sends out a signal as a change in potential; and second, the receiver which accepts the transmitted signal and produces a written record.

The pickup or pressure transducer, although partially mechanical in its use of a diaphragm or expanding tube, is designed to have a high natural frequency and minimum hysteresis and inertia. Many of the transducers now commercially available are not self-generating and therefore require an outside source of power which is changed or modulated by the transducer to provide a signal. This power supply and transducer are not often located physically at the same point. However, the two pieces of equipment may be considered electrically as making up the transmitting unit.

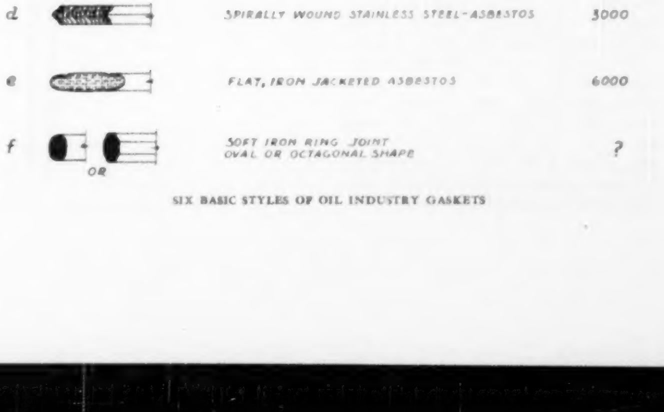
Since the electrical output or signal from the pickup is usually too low for direct feed into a recording instrument, it is necessary that an amplifier be provided. The function of this instrument depends primarily upon the requirements of the recorder and can thus be considered a part of the receiver-recorder unit. The recorder receives the amplified signal from the pickup or transmitting unit and produces a trace on a chart or sensitive paper or film.

It is not probable that there is one combination of pickup and recorder suitable for all pipe-line pressure-surge problems, although certain combinations do offer greater flexibility of application and range of usefulness than others.

Oil Industry Gaskets, by H. H. Dunkle, Jun. ASME, Johns-Manville Sales Corporation, New York, N. Y. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-6** (mimeographed).

THE oil industry has been the most important factor responsible for the development and growth of the metallic-gasket industry. This was one of the first to require the use of innumerable joints that could be easily disassembled in lines and vessels handling a wide range of pressures and temperatures. In the last few years, the pressure limits have been extended to include a range from a full vacuum to 30,000 psi, and the temperature limits range from 320 F below zero to nearly 2000 F.

In spite of the range of temperatures and pressures that must be held and the wide variation in the equipment to be sealed, relatively few of the available materials and styles of gaskets are in general usage in the oil industry. Any discussion of gaskets can be confined to six basic styles. This paper outlines the merits and limitations of each of these gaskets and points out various features of installation technique or closure design



SIX BASIC STYLES OF OIL INDUSTRY GASKETS

that may have an effect upon their performance.

Nonmetallic gaskets such as those cut from sheet packing and similar relatively soft materials may be readily seated or sealed in the flanged joints normally used throughout the oil industry. However, metallic gaskets, being fabricated from hard materials, are much more difficult to seal, and a brief review of the problems of gasket design will help to explain the relative merits and limitations of the different types.

Steam and Power Plant Economy and Capability at Louisiana Station, by R. J. Robertson, Mem. ASME, and W. B. Gurney, Mem. ASME, Gulf States Utilities Company, Lake Charles, La. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-8** (mimeographed).

THE year 1950 marks the 20th anniversary of the first delivery of steam and by-product electricity by Gulf States Utilities Company to the Esso Standard Oil Company Refinery at Baton Rouge, La. In 1929 the refinery experienced the need for additional steam and power together with the problem of disposing of nonmerchantable waste fuels. Successful negotiations were made between the refinery and the company and a long-term contract was signed. Land was purchased adjacent to the refinery, a power plant was designed, constructed, and placed in operation in the record time of six months after contract signing. In 1938 the Ethyl Corporation was added as another steam-electric customer. Through these past 20 years the industrial and domestic need for power in the area served by Gulf States Utilities Company have made it necessary to increase Louisiana Station capacity from 45,000 kw to 210,000 kw. At the same time, boiler capacity has been increased from 1,400,000 lb per hr to 4,350,000 lb per hr. Present contracts with Esso Standard and Ethyl alone account for 120,000 kw and 1,880,000 lb per hr of 135 psi 438 F, process-steam demand on the station.

The power station is composed of two sections. The first or original 600-psi section has a capability of about 120,000 kw for maximum process-steam demand.

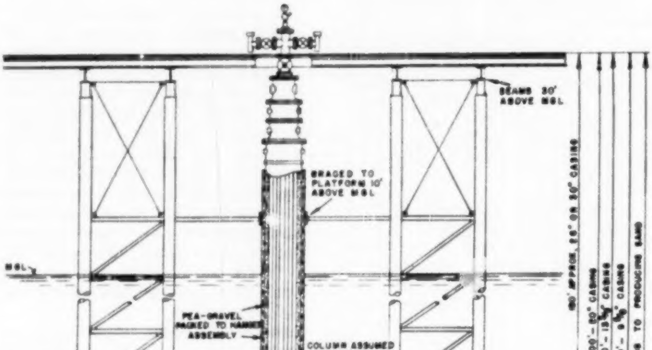
The second or new 900-psi section contains two 900-lb 900 F independent power-generating unit systems each having a name-plate rating of 40,000 kw and a maximum capability of 50,000 kw. These units have no evaporators, but receive make-up water from the condensing units in the 600-lb section.

The production of electric power by turbines using high-pressure steam, then exhausting it at low pressure to supply steam for heating and process requirements, is a major method being used more and more to obtain the maximum utilization of the heat and energy in fuels. Since 1930 the Louisiana Station has not only used this process of producing so-called by-product electric energy, but has also conserved some fuel due to successful burning of waste fuels that would ordinarily need to be replaced with conventional premium fuels such as fuel oil and natural gas.

The Louisiana Station has had to solve numerous problems during its business of producing electricity and steam economically. The most critical of these were the disposal of waste fuels, the generation of steam with high make-up treated river water, and heat improvements.

Allowable Loads on an Unsupported Casing Column Under Action of Horizontal Wave Forces and Vertical Wellhead Loading, by J. A. Reed, II, and H. H. Meredith, Jr., Mem. ASME, Humble Oil and Refining Company, Houston, Texas. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-5** (mimeographed).

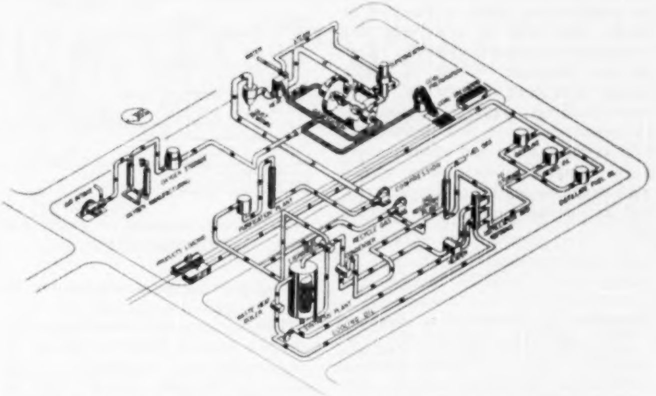
THE completion of offshore oil and gas wells with conventional wellheads poses the problem of an unstable casing column. This paper presents a method for determining the allowed wellhead loading for such a column. A casing



TYPICAL COMPLETED OFFSHORE OIL OR GAS WELL

program is described and used in computations throughout the range of the investigation for normal water depths from 30 to 60 ft. Consideration is made of the horizontal forces acting on a round vertical column induced by the maximum probable breaking wave to be expected under hurricane conditions in the Gulf of Mexico at the design water depth with allowances for storm tide. The evaluation of these wave forces is discussed in the light of various theories which have been proposed.

A graphical method is shown for the determination of the stresses and deflections induced in a casing column by the wave-force distribution computed from the theories accepted.



FLOW SHEET SHOWING THE PRINCIPAL OPERATIONS OF THE GAS-SYNTHESIS DEMONSTRATION PLANT

The Bureau of Mines Gas-Synthesis Demonstration Plant at Louisiana, Mo., by R. G. Dressler and J. R. Bircher, Bureau of Mines, Louisiana, Mo. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-9** (mimeographed).

AT Louisiana, Mo., the Bureau of Mines has completed two demonstration plants employing different processes for converting coal into synthetic liquid fuels. Both were designed and erected under the authorization of Public Law 290 (78th Congress, April 5, 1944), which, as amended, provides for an 8-year research and development program on the production of synthetic liquid fuels from coal, oil shales, and agricultural products.

The first installation at Louisiana, the Coal-Hydrogenation Demonstration Plant, was discussed in a paper presented before the 1949 ASME Petroleum Division Conference at Oklahoma City, Okla. It employs the direct hydrogenation or Bergius-I.G. Farben process with certain modifications and engineering improvements.

The Gas-Synthesis Demonstration Plant, completed this year, will gasify pulverized coal with oxygen and superheated steam and then convert the resulting synthesis gas—a mixture of carbon monoxide and hydrogen—to liquid fuels by a modified Fischer-Tropsch process.

This paper is concerned with the Bureau of Mines Gas-Synthesis Demonstration Plant. Each plant unit and process to be employed is described. In a series of brief discussions, attention is directed to the several new engineering and process features which are incorporated into the plant.

The capacity of the Gas-Synthesis Demonstration Plant is 80 to 100 bbl per day of hydrocarbon product. The anticipated daily production of liquid-hydrocarbon products will include 55 to 60 bbl of gasoline, 10 to 12 bbl of Diesel oil, and approximately 12 bbl of heavy oils and waxes suitable for cracking stock. These proportions may be changed appreciably, however, by changing synthesis operating variables of temperature, pressure, space velocity, hydrogen:carbon-monoxide ratio, recycle rates, and type of catalyst.

Operating Experience With the Coal-Hydrogenation Demonstration Plant, by C. C. Chaffee and E. A. Clarke, Bureau of Mines, Louisiana, Mo. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-10** (mimeographed).

THE 200 to 300-bbl per day capacity Coal-Hydrogenation Demonstration Plant at Louisiana, Mo., has completed five runs during its first year of testing and operation.

The first was a vapor-phase run at 10,000 psi to hydrogenate petroleum and lignite-tar oil distillates to high-quality Diesel fuel and motor gasoline. After the vapor-phase run it was considered advisable to reweld all $^{3}/_{8}$-in. nozzles on the high-pressure piping, which required an extended shutdown to complete. Four runs have been made on the liquid-phase unit, the first being a 2-month exploratory tar-oil run to test the performance of equipment and instrumentation. This run was followed by a second long shutdown in which more than 50 important process and equipment changes were incorporated in the plant. Three runs have followed, in which substantial improvement in operation was attained and several hundred tons of coal were hydrogenated. However, troubles with injection pumps and instruments, particularly those measuring temperature, persisted and caused early termination of the first two runs. Further changes in pumping equipment and instrumentation, along with improvements in paste preparation and solids removal from heavy recycle oils, are making possible longer runs for the production of synthetic fuels for use in a military fuel-testing program.

Preparation of Synthetic-Fuel Cost Estimates by the Coal-to-Oil Demonstration Branch, by L. C. Skinner, Bureau of Mines, Louisiana, Mo. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-11** (mimeographed).

THE widespread interest in the cost estimates made by this branch makes it timely to relate the reasons for making the estimates, the methods used, and some of the results achieved. Estimating is an important function of any engineering organization. Any group doing development work in a free-enterprise nation such as this must be interested in costs and cost estimates because an uneconomical process has little chance of lasting success.

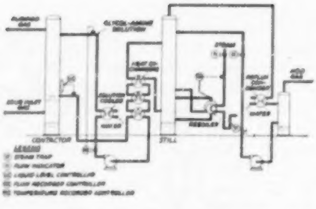
The economic horizon for synthetic fuels is more distant than the majority of industrial assignments requiring evaluation on the basis of the immediate conditions. There is no better yardstick for determining the relative merits of the numerous existing processes for making synthetic fuels, as well as the many improvements continually being developed, than the cost of production.

The method of preparing cost estimates

for synthetic-fuel plants is described in detail, each step is explained, and examples are included to illustrate. Cost elements discussed consist of major process equipment, foundations, structures, buildings, piping, electrical, instruments, insulation, and painting, as well as the indirect and administrative costs. Sections are included on operating-cost calculation and off-site facilities, such as housing, transportation, and the like.

Corrosion in Amine Gas Treating Plants, by F. C. Riesenfeld and C. L. Blohm, The Fluor Corporation, Ltd., Los Angeles, Calif. 1950 ASME Petroleum Mechanical Engineering Conference paper No. **50—PET-16** (mimeographed).

THERE are two general means of successfully attacking the problem of corrosion of carbon-steel equipment in amine-gas-treating plants. One of these approaches consists of adopting certain process adjustments and operating precautions. Among these, solution temperature in the hottest pass of the heat exchangers, degree of saturation of the solution, and elimination of sources of oxygen have been found to be most important in glycol-amine plants. By adjusting these factors properly, corrosion of heat exchangers, which is most commonly observed in such plants, can be reduced materially. In aqueous amine systems, the reboiler temperature and the presence of oxygen and oxidation products in the solution appear to be the prime causes for corrosion of carbon-steel equipment, especially reboilers, stills, and solution exchangers. By maintaining the proper reboiler temperature and preventing oxygen contamination of the solution, corrosion has apparently been controlled to an appreciable extent. Neutralization of corrosive contaminants and reactivation of inactivated amine by the addition of strong inorganic bases and steam distillation have also been reported to be beneficial. No conclusive evidence is available as to the effectiveness of corrosion-inhibiting agents. It should be pointed out that, although the presence of oxygen and oxidation products undoubtedly aggravates corrosion, laboratory experiments and field experience have shown that corrosion can be obtained in oxygen-free systems, provided other factors conducive to corrosion are present. Stress-relieving of all major vessels is also indicated by experience to be desirable. Although some benefit will be derived from these measures, in general they will be accompanied by certain sacrifices in process efficiency or increase in operating expense.



TYPICAL FLOW DIAGRAM OF AMINE GAS TREATING PROCESS

The other approach which appears to offer the greatest benefit is the use of corrosion-resistant materials in areas subject to excessive attack. The experiments reported in this paper indicate that aluminum 3S and 4–6 Cr-$^1/_2$ Mo steel are suitable materials for use in heat exchangers in glycol-amine plants, while 304 and 316 stainless steel, Monel, Inconel, and Carpenter 20 steel have shown good resistance to corrosion in aqueous amine systems operating at various conditions. The use of alloys will effectively reduce corrosive failure in most cases while permitting maintenance of plant operation at optimum conditions. However, it should be pointed out that in certain existing installations it may not be at all feasible to make suitable process adjustments in accordance with the first approach just mentioned, in which case the use of corrosion-resistant materials is almost mandatory.

In the design of new plants, every consideration should be taken of proper adjustment of process variables to give optimum corrosion protection; but again, the use of alloys should be included in balancing an economic evaluation and process efficiency against investment and operating costs.

Finally, it should be pointed out that most of the experimental work described in this presentation has been confined to systems employing glycol-amine solutions of relatively low water content, and that conclusions advanced in regard to the use of materials such as aluminum and 4–6 Cr-$^1/_2$ Mo steel should not be assumed to apply to aqueous amine systems without due precaution.

Instruments

Vector Meter, by Otto Jensen and C. R. Crewson, I.T.E. Circuit Breaker Company, Philadelphia, Pa. 1950 ASME Industrial Instruments and Regulators Division-Instrument Society of America Meeting paper No. **50—IIR-5** (mimeographed).

THE vector meter consists of a moving-coil-type d-c millivoltmeter connected in series with the contacts of a small single-phase mechanical rectifier. These contacts are opened and closed in synchronism with the frequency of the circuit to be measured by means of an eccentric, driven by a synchronous motor employing a shaded-pole starting field and a double-pole synchronous field. Contacts are made of 24-K gold. The contact resistance is so high while the contact is opened and so low while the contact is closed that this resistance can be neglected in so far as the accuracy of the instrument is concerned.

The meter can be used as a direct-reading instrument indicating a-c volts; a d-c voltmeter or ammeter; etc.

ASME Transactions for November, 1950

THE November, 1950, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

TECHNICAL PAPERS

Optimum Tube Size for Shell-and-Tube-Type Heat Exchangers, by F. D. Cardwell. (50—S-6)

Loss Coefficients for Abrupt Changes in Flow Cross Section With Low Reynolds Number Flow in Single and Multiple-Tube Systems, by W. M. Kays. (50—S-7)

Heat-Transfer and Flow-Friction Characteristics of Some Compact Heat-Exchanger Surfaces, by W. M. Kays and A. L. London.

Part I, Test System and Procedure.

Part II, Design Data for Thirteen Surfaces. (49—A-95)

Calibrations of Six Beth-Flow Meters at Alden Hydraulic Laboratory, Worcester Polytechnic Institute, by L. J. Hooper. (49—A-38)

Latest Technique for Quick Starts on Large Turbines and Boilers, by J. C. Falkner, D. W. Napier, and C. W. Kellstedt. (50—S-1)

Sealing of High-Pressure Steam Safety Valves, by R. E. Adams and J. L. Corcoran. (50—S-24)

New Method for Bulk-Modulus Determinations, by S. L. Kerr, L. H. Kessler, and M. B. Gamet. (50—SA-32)

Measurement of Temperatures in High-Velocity Steam, by J. W. Murdock and E. F. Fiock. (50—S-36)

Relay Servomechanisms, by T. A. Rogers and W. C. Hurty. (50—S-13)

Cable-Pulley Friction, by W. E. Schorr. (50—S-17)

COMMENTS ON PAPERS

Including Letters From Readers on Miscellaneous Subjects

Cam-Follower Systems

Comment by Philip Barkan[1]

This paper[2] was particularly interesting to us since, currently, we are conducting an investigation of the dynamics of valve linkage and springs on internal-combustion engines. The dynamics of the linear oscillator, such as a cam follower, have been treated in some detail in many texts on mechanics.[3] Thus it is surprising that cam designers have neglected consideration of this important phase of the work for so long.

It is not difficult to demonstrate mathematically the phenomenon of resonance, and arrive at conclusions as to what constitutes good cam design.

Starting with the differential equation for a linear oscillator under the action of an arbitrary driving force

$$M \cdot \frac{d^2x}{dt^2} + b \cdot \frac{dx}{dt} + K \cdot x = F(t)$$

The solution for this equation may be put into the form

$$R = K \cdot x = K \cdot \sum_{n=0}^{\infty} \frac{F_n}{M} \cdot \frac{\cos(\omega_n t - \alpha)}{\sqrt{(\omega_0^2 - \omega_n^2) + \frac{b^2}{M^2}\omega_n^2}}$$

where

α = phase angle
b = damping factor
R = resultant dynamic force
$F(t)$ = external driving force
F_n = amplitude of nth harmonic of harmonic analysis of $F(t)$
K = system elasticity
M = effective mass of cam-follower system from equilibrium position
x = deflection of cam-follower system
ω_0 = natural frequency of system, radians per sec $= \sqrt{\frac{K}{M}}$
ω_n = frequency of nth harmonic, radians per sec

Examination of the equation shows that resonance occurs at speeds which are multiples of the natural frequency of the system. With small b, the value under the square-root sign becomes very small when $\omega_0 = \omega_n$; consequently, the contribution to the complete solution of that member which is in resonance is by far the largest. With a given cam-follower system, the magnitude of the response at resonance will depend primarily upon the magnitude of the component F_n. By performing a harmonic analysis of the forces acting on the system, it is possible to predict the response with a given cam operating at a given speed. The principal force acting on the system is the acceleration force. Therefore, a harmonic analysis of the acceleration forces produced by a given cam design will give an indication of the performance to be expected.

In general, any periodic function, provided that it contains no more than a finite number of discontinuities, has a convergent Fourier series which represents it. However, the number and extent of the discontinuities have an important bearing on the rapidity of the convergence, i.e., the rate at which the harmonics approach zero as n becomes large. If a function itself has discontinuities, the coefficients will decrease in general as $1/n$, whereas, if discontinuities do not exist in the function itself, but only in its first derivative, the coefficients will fall off approximately as $1/n^2$.[4]

Examination of the three acceleration forms considered in this paper shows that only the cycloidal is completely continuous. It is stated that the cam-follower system used has a natural frequency of 162.5 cycles per sec (9750 cycles per min). At a cam speed of 140 rpm, resonance occurs with the harmonic 9750/140 = 70th harmonic.

Therefore, we would anticipate that the resonant response of the system to the cycloidal cam profile would be in the order of $^1/_{70}$ of the response to the other two profiles at this speed.

From the considerations of convergence, it also may be concluded that the natural frequency of the cam follower should be as high as possible, so that resonance, in a given speed range, occurs only with the higher number and, consequently, smaller amplitude harmonics. Obviously, by using the acceleration form with a rapidly converging harmonic analysis, we can afford to allow resonance with lower number harmonics, and thus have less rigid requirements on the natural frequency of the system.

In general the criteria of a successful cam profile are that its acceleration curve be continuous, the rate of change of acceleration be small, and also the derivatives of the acceleration curve be continuous. This latter condition is greatly limited in practice by the accuracy to which cam profiles may be produced.

With these general criteria, it is possible to design a cam by numerical integration, when necessary, without recourse to specific equations.

[1] Research Assistant, The Pennsylvania State College, School of Engineering, State College, Pa.

[2] "Tests on Dynamic Response of Cam-Follower Systems," by D. B. Mitchell, Mechanical Engineering, vol. 72, June, 1950, pp. 467–471.

[3] "Mechanics," by J. C. Slater and N. H. Frank, McGraw-Hill Book Company, Inc., New York, N. Y., vol. 1, 1947.

[4] "Theory of Approximation," by D. Jackson, American Society Colloquium Publications, vol. 11, 1930, p. 123.

Comment by John A. Hrones[5]

A cam-follower system similar to the one on which the author conducted his tests was studied analytically.[6] The results of this analysis predict very closely the measured data shown in Figs. 4, 6(*a*), and 6(*b*) of the paper. The use to which the author puts the word "theoretical" is, therefore, questionable, since the inclusion of follower stiffness and mass in a theoretical analysis does yield results which check the measured values. As a matter of fact, it is surprising and comforting to observe that the inaccuracies in cam contour and

[5] Professor of Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, Mass. Mem. ASME.

[6] "An Analysis of the Dynamic Forces in a Cam-Driven System," by J. A. Hrones, Trans. ASME, vol. 70, 1948, pp. 473–482.

backlash in the actual system caused little deviation from the analytical predictions.

This paper represents a real contribution and indicates the increased indexing speeds which are possible when attention is paid to the dynamic behavior of the system under consideration in the design stages.

COMMENT BY CYRIL O. RHYS[7]

Some 25 years ago the writer spent considerable time on the problem of a fast-running cam, with a small angle of rise, for an experimental machine. Parabolic and harmonic cams had been tried, but they simply could not be kept in contact with the cam roll. Undoubtedly, this was due to the sudden accelerations, which had to reach their full amount during the deformation period of the material.

A cycloid cam, however, performed in a very satisfactory way, under extremely hard conditions, oscilloscope observations showing that contact between the cam and the roll was unbroken. There could be no doubt that the extra steepness of the cam profile was negligible, as compared with the advantage gained by increasing acceleration gradually instead of the positive blow which must be given by the other types.

Not only does the cycloidal cam have gradually changing acceleration (and therefore force), but there seems reason to believe that it is of about the optimum shape for the moving of a mass against its inertial resistance.

Suppose a cycloid curve to hang, vertex down, from its ends (like the catenary for a hanging chain), and let a particle, under the action of gravity, start from one end, sweep down to the vertex and then on up to the other end. The projection of its motion on the horizontal line joining the ends is the motion produced by a cycloid cam. As it is known that the particle gets from the end to the vertex in the minimum time (Brachistocrone or curve of quickest descent), it would seem reasonable to suppose that the inertial resistances to be overcome are less severe than with any other path.

The author's equation for the cycloid cam can be put into the shape

Displacement $= x = r(qt - \sin qt)$

with the derivatives

Velocity $= v = rq(1 - \cos qt)$

Acceleration $= dv/dt = rq^2 \sin qt$

where q = angular velocity of the cycloid generating circle, r = its radius, and t = time. From these equations, it can be shown readily that the motion of the particle mentioned is that of a point on the circumference of a generating circle rolling with an angular velocity of $\sqrt{g/r}$ radians per sec. This would give the author's cam an rpm of 65. Higher speeds for it, of course, would correspond with gravitational fields with $g > 32.2$.

It is noted that the author finds extreme accuracy of machining to be necessary. This agrees with the writer's experience just cited, in which a special measuring device, attached to a milling machine, had to be used. From the noncycloidal cams, it was obvious that great vibrations were taking place. It is instructive to observe from the author's experiments, how great these vibrations actually can be, and that they do not die out until the dwell period is reached. He is to be congratulated on having obtained some very interesting and valuable data.

COMMENT BY G. I. TALBOURDET[8]

It is gratifying to note that for some time real efforts have been made to obtain a better understanding of the various factors influencing the motion of cam-driven mechanisms. The importance of the type of cam profile, mass, elasticity, dry, and viscous friction of cam-follower systems is now recognized and well on its way to lead to a better and more efficient cam design. Hence any analysis and laboratory tests, such as the present paper describes, throwing some light on the behavior of cam and follower systems are indeed a valuable contribution to this field of engineering.

Referring to the author's test apparatus: the use of a substantial flywheel on the driving camshaft is important because with such a reservoir of energy, fluctuations in the angular speed of the cam should be definitely minimized and probably nullified.

As a complement of Fig. 1 of the paper, a diagram showing the mounting of the sliding and swinging followers and the location of the strain gages should have been included in the paper.

The use of electric strain gages to measure the forces exerted on the follower appears to be satisfactory, but does not the electrical network introduce some characteristics of its own in the recorded output? In addition, the recording arm of the Brush oscillograph may be subjected to mechanical vibrations causing overthrows. It is also felt that the displacement output under different speeds should have been recorded and compared with the input to the follower. A tabulated follower input for every degree of rotation of the cam and for each of the three types of motions may have been of value.

From our experience with internal-groove plate cams, we have come to recognize the importance of the clearance between roller and cam track. In the writer's opinion a variation of ± 0.001 in. does affect the follower output motion, and it would be of interest to test further influence of this variation.

While much research work remains to be done on this interesting and important phase of machine design, the findings of the author, which are the results of actual tests, indicate definitely that the peak and oscillatory forces produced in a cam-follower system of given mass, elasticity, and damping are entirely different from the calculated theoretical values.

This paper should do much to dispel the erroneous impression that the peak acceleration is more important than the rate of change in acceleration, one of the controlling factors in good cam design.

AUTHOR'S CLOSURE

The discussion of this paper shows a continuing and increasing interest in the field of cam dynamics, an interest which was largely confined to kinematics until fairly recently.

Mr. Barkan's method of analysis is an interesting aspect of the problem. The possibilities of direct integration of a desirable acceleration curve were considered when this paper was written. Although no investigation of that approach was made, it seems obvious that some desirable motions might result. The method of harmonic analysis will be of particular value in a study of directly integrated curves.

Dr. Hrones' comment on the use of the word "theoretical" is well taken. The intended application of the word was in description of analysis based purely on the kinematics of a system. If, as Dr. Hrones points out, the correct theory is used, the correct result follows.

Mr. Rhys' reference to the brachistochrone is interesting and one which the writer had not previously considered. The horizontal component of the motion of a mass particle on a suspended cycloid is, indeed, that produced by a cycloidal cam. However, this fact does not necessarily support the statement that the

[7] Mechanical Engineer, Standard Oil Development Company, Elizabeth, N. J. Mem. ASME.

[8] Research Division, United Shoe Machinery Corporation, Beverly, Mass. Mem. ASME.

cycloidal cam might have the optimum shape for moving a mass in an actual system where the mass is coupled to the cam by members which introduce elasticity and damping. A case in point is that of a cam which has no dwell. In this case the acceleration and forces produced by a harmonic cam are much less than those produced by a cycloidal cam. In any actual cam system, dynamic transients are introduced by minute irregularities in the cam profile, as well as by the basic design of the profile. In general, we are interested in peak values of the forces or transients, and it follows that a reduction in the causes of these disturbances will result in lower dynamic peaks. If, in an actual system, a mass m is coupled to a cam by members of stiffness k and damping coefficient b, then the force on the mass will be

$$F = k(x_m - x_c) + b(\dot{x}_m - \dot{x}_c)$$

$$\text{or}\quad F = m\ddot{x}_m$$

where x_m = mass displacement
x_c = displacement dictated by cam
$\dot{x}$ = velocity
$\ddot{x}$ = acceleration

However, F does not equal $m\ddot{x}_c$ in any but the ideal system where the coupling between mass and cam has infinite stiffness and no damping. This is a most important point in that smoothness of operation can only be achieved as the actual acceleration of the mass is made to approach that dictated by the cam. For this to happen, the rate of change of cam acceleration must be made smooth, and a first attempt at this is the cycloidal cam. If we can eliminate sudden changes from the values of $\frac{dx_c^3}{dt^3}$, $\frac{dx_c^4}{dt^4}$, etc., we can make smoother-operating cams by elimination of transients. In actual practice, this is extremely difficult because of machining difficulties. Tests made to date on a cam calculated to have no discontinuities in the value of $\frac{dx_c^3}{dt^3}$ show practically no difference in results from tests made with the cycloidal cam.

The accompanying sketch, Fig. 1, shows the arrangement of the elements of the testing machine. The sliding and swinging followers could not be used at the same time, but provision was made for their easy interchange. In each case, a complete strain-gage bridge was used on the sensing member.

The electrical circuit could not introduce characteristics of its own as suggested by Mr. Talbourdet, because of the nature of the equipment used. The amplifier makes use of a modulated carrier system which will pass only the carrier frequency and its modulation as caused by the strain gages. The equipment has been used in areas of extreme electrical disturbance, none of which ever appeared on the finished records. In the test work considered here, although frequencies as high as 162.5 cps were noted, tests were not attempted with follower frequencies in that range with this equipment. The recording oscillograph was only used at frequencies up to about 50 cps, which is well within the linear range of the instrument. It had been necessary to record frequencies higher than 100 cps, the results would have shown electrical underthrows rather than overthrows because of the inability of the instrument to respond. Slight mechanical overthrows of the pen do exist, but they are not over 5 per cent of the nominal values. A complete dynamic analysis of the direct-recording oscillograph elements may be found in an article entitled "Electrodynamic Direct Inking Pen," by H. B. Shaper, which appeared in *Electronics* for March, 1946, pages 148–151.

Oscillograph records were made of the follower displacement, but measurements of displacement variations to the accuracy required could not be made. As stated in the basic paper, the cam profiles themselves were measured after cutting and they were cut with the best available technique. Roller clearances were held to an absolute minimum, so that backlash effects would be as small as possible. One of the effects of increased clearance would obviously be an increase in transient production with resulting increases in peak loads, and poorer operation.

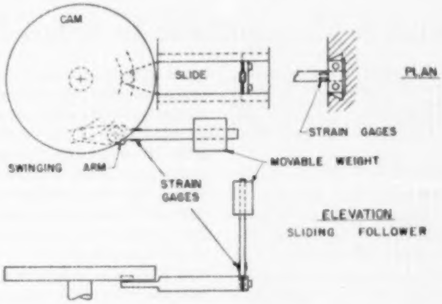


FIG. 1

D. B. MITCHELL.[9]

[9] Mechanical Research Engineer, E. I du Pont de Nemours & Company, Wilmington, Del. Jun. ASME.

Hot-Spot Machining

TO THE EDITOR:

It was gratifying to read on pages 653 and 654 of the August issue of MECHANICAL ENGINEERING a note on a report of hot-spot machining research conducted for the U. S. Navy's Bureau of Ships.

In 1939 I gave some thought to this subject. I was unable to carry on investigations to verify the conclusions I reached, but I find in my files the following statement of them prepared at that time:

"The following bears on the subject of cutting very hard metals and is based on the following phenomena:

(1) If steel is heated to about 900–1000 F, its tensile strength goes down to about one half.

(2) If the surface of the steel is heated to a temperature of about 2100 F, the temperature of same about $^1/_8$-in. below the surface in about 2 or 3 seconds will be not less than 900–1100 F.

(3) High-speed tool steel does not lose its cutting qualities even if the temperature of the tool made from it reaches the temperature of 1800–1900 F.

"If therefore, a cut is to be taken in a planer or in a lathe, the resistance of the metal to cutting can be materially reduced if we direct a torch flame on the surface to be cut and close to the cutting tool.

"In other words, a torch attachment moving with the cutting tool and properly adjusted will permit cutting even very hard metal with less resistance."

R. B. POLIAKOFF.[10]

[10] New York, N. Y. Mem. ASME.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

Production Management in Small Plants

Production Management in Small Plants, By Frank K. Shallenberger. Graduate School of Business, Business Research Series No. 5, Stanford University, Stanford, Calif., 1950. Paper, 6 × 9 in., iv and 44 pp., $0.50.

Reviewed by J. M. Juran[1]

THIS booklet compresses into a small space (44 pages) many correct principles and much sound observation concerning small-plant management. As such, it warrants widespread circulation.

There is doubt that a small-plant manager will derive much specific aid from such a statement of principles. So often the practical problem is how to make the principles effective. The booklet is probably too brief to be specific on "how to do." A modicum of diagrams, forms, and other graphic devices would be of aid here.

There is great need, and a vast market for a well-written, well-documented and integrated book on small-plant management. The ASME book[2] is a series of chapters, each by an authority on some subdivision of the subject. The advantage is the expertness thus applied to each topic. The limitation is the lack of thorough integration. The topics were indeed born out of a common plan. But the treatment of the topics bears the variegated styles of the numerous experts, and not the even hand of a single authorship.

It is encouraging that such books are being written at all. The small businessman needs know-how served up to him to minimize the mistakes he makes in acquiring know-how through experience alone.

In the case of the farmer and the housewife, government agencies have stepped in to provide much literature of know-how. Now and then this government literature goes beyond the point of diminishing returns, but the basic recognition of the need for know-how is there all the same.

In like manner, there is a vast need among small businessmen for practical know-how. It will be interesting to see whether private industry can get there ahead of the government on this one.

[1] Chairman, Department of Industrial and Management Engineering, New York University, New York, N. Y. Mem. ASME.

[2] "Small Plant Management," edited by E. H. Hempel, McGraw-Hill Book Company, New York, N. Y., 1950.

Research Administration and Organization

Scientific Research: Its Administration and Organization. Foreword by Catheryn Seckler-Hudson. Edited by George P. Bush and Lowell H. Hattery. American University Press, Washington, D. C., 1950. Cloth, $6^1/_2 \times 9^1/_2$ in., viii and 190 pp., $3.25.

Reviewed by Ivan C. Crawford[3]

THIS book presents papers given at an institute on the administration of scientific research and development held in Washington, D. C., by the American University with the co-operation of the National Research Council and the American Association for the Advancement of Science. The editors have contributed the opening and closing chapters, the latter summing up skillfully the proceedings of the institute.

In part 1, research organization, the first paper describes the administration of sponsored research as it is handled at one state university. Inasmuch as the engineering experiment stations of the land-grant colleges depart to a considerable degree in their methods of handling work and in organization, another paper on this subject would have helped to set forth the situation on the campuses. Other topics treated in this part are: problems in the co-ordination of technical research, responsibility for planning research, committee versus staff, and government research contracts. The paper devoted to the last topic recites the troubles experienced by the universities with the provisions of government research contracts and the lack of uniformity among the government departments in contract requirements and methods of payment and vouchering research costs.

Part 2, Administrative Process, consists of three papers. The first covers the responsibilities of research directors under the headings of planning, execution, and review, all from the technical standpoint and considers the administrative responsibilities such as relations to the supervisor, relation to supervised, and relations to internal and external groups. The remaining papers in this part, planning a research program, and maintaining a schedual for research activities, are the only papers in the book written by authors working in the industrial field.

The subject of research personnel is considered in part 3. Titles to the five papers on this topic are: selection of the research worker, professional development of personnel, significance of fellowships in training research workers, incentive from the viewpoint of science, and incentive from the viewpoint of the psychologist. Continuance of graduate study for those employees with bachelor's degrees only is discussed in the first paper. The next paper is also concerned with this subject, especially with reference to off-campus programs of universities. Incentive from the viewpoint of the scientist is discussed under the headings of advance training, assistance and equipment, financial considerations, retirement prestige and recognition, and professional group meetings. The last paper looks at the size of the research organization and also considers such topics as identification with management, improving morale, bettering communications, supervising as an incentive, and research freedom as an incentive.

Part 4 deals with aids to research: budgeting and analyzing cost for the research program, budgeting the research program, budgeting and cost accounting in research institutes, internal informational aids to research. With the exception of one paper all are written from the background of governmental research organizations.

Research product is the subject of part 5. Replication of research effort and duplication of effort in research and development programs are the titles of the first two papers. In each the necessity of more than one investigation on the same problem is emphasized.

[3] Dean, College of Engineering, University of Michigan, Ann Arbor, Mich.

The subject is further discussed in the third paper under the heading of duplication in research and development.

Publication and dissemination of research results is the subject of the fourth paper. The writer states that the only way to communicate the results of research is through the medium of the scientific journal. He then discusses the cost involved and the large amount of material which is not published on account of lack of space. Among solutions suggested are increased publication charge rates, solicitation of special grants or subsidies from foundations, from industries, or from agencies who are interested in research including the government.

The fifth and last paper is entitled research reporting, evaluations and utilization. This is written largely from experience in the Bureau of Agricultural and Industrial Chemistry, Department of Agriculture. The objectives in research reporting are to keep the organization informed, to brief the superiors of the organization, and to inform the users of the research of findings. Evaluations come through division heads and chiefs of bureau in conferences with collaborators.

Part 6 contains one paper—principles of administration in research environment—and is devoted to a summing up of the other papers presented to the Institute. This section presents succinctly and clearly the meat of the previous papers. One or two extractions may be of particular interest: "The concept that research cannot be planned is both correct and incorrect. It depends upon our terms of reference, upon the totality viewpoint versus the limited viewpoint. In general, it can be presumed that to the extent the elements of a research project are planned to that same extent will its prosecution be expedited"; and again, "Budgeting as a staff function in the field of administration differs somewhat, but not too much, from its use elsewhere in administration. The element which causes this difference is the unpredictability of the creative mind. Budgeting for research can reasonably forecast the certain obvious costs for a definite period of time only. Even this is a distinct contribution."

This book is an interesting and valuable record of experience in research administration, particularly from the viewpoint of government bureaus. The field of research administration is too broad to be covered at one meeting of an institute. Consequently blank spots in the picture are to be expected. Certainly it is desirable that research administration policies in industry and also in our universities and colleges be subjects of similar institutes.

Principles of Scientific Research

THE PRINCIPLES OF SCIENTIFIC RESEARCH. By Paul Freeman. Public Affairs Press, Washington, D. C., 1950. Cloth, $5^1/_4 \times 8^1/_2$ in., 11 fig., index, xi and 222 pp., $3.25.

REVIEWED BY G. A. HAWKINS[4]

THE author believes that young men and women embarking on scientific research as a life career usually must go through a groping process in order to learn how scientific research work should be carried out. This stage of their learning process is referred to as "learning by experience." The main objective of the text is to help these young men and women during this stage of their development. The book is concerned with scientific research and deals with it as a whole, and should prove to be of value to young people interested in research. In the opinion of the reviewer, the author has fulfilled his objective. Young men and women engaged in research would gain a great deal of information by carefully reading the text and studying its contents.

[4] Associate Director, Engineering Experiment Station, Purdue University, Lafayette, Ind. Mem. ASME.

In the first three chapters the author presents his views regarding the nature of scientific research and its historical background. During the early part of the discussion, definitions for science and research are presented. The historical discussion in the second and third chapters has been skillfully written. This section of the text contains many interesting discussions covering many of the famous scientists of the past and their contributions. By carefully weaving the human side into the story, the author has made this material attractive and interesting to read. A student who would skip this material in a desire to read about such items as planning and organization would lose a good deal of background material.

Following the material dealing with the historical aspects, the author discusses in chapter 4, his ideas as to the qualities necessary in young men and women to achieve success in scientific research. These qualities are clarity of mind, a combination of imagination and caution, of receptivity, and skepticism, of patience and throughness and ability to finalize, of intellectual honesty, of a love of discovery of new knowledge and understanding, and singleness of purpose. A significant statement of the author is "of these the most important is the love of discovery of new knowledge and understanding. If any young readers, contemplating scientific research as a profession, do not feel this love, they need read no further—scientific research is not for them. Let them choose another profession, less arduous and more remunerative. But if they feel this love, then the author begs them to read on, for it is chiefly for them that this book was written." Throughout this chapter the author presents many bits of valuable advice, one of which is presented to illustrate the type of suggestion. "Immediately upon starting on the first serious piece of research work a young scientist must therefore do two things. The first of these should be a careful reading of original papers or books relating to the problem, written by investigators whose technique and judgment he can trust."

Chapters 5 and 6 constitute an excellent detailed discussion of the planning of research. The author presents many ideas, which should be thought-provoking not only for the young research worker but for the experienced scientist as well. Choice bits of wisdom such as "Young scientists, lacking experience which time alone can bring, are apt to be charmed by ingenious and elegant devices which are really useless to them," are inserted throughout the discussion. Those who have dealt with graduate students in university work, often encounter this type of feeling on the part of the inexperienced student.

In chapter 7 entitled Organization, the author discusses in one part the subject of individual work as contrasted with scientific teamwork. This particular material is very interesting.

Chapter 8, Experimentation-General Conditions, covers a large number of problems which usually confront the young investigator. Such subjects as discussions, use of reference library facilities, allocation of credit for work done, and the status of the junior research worker are covered. The last section of the chapter deals with advice to the young scientist as to what to expect from superiors and responsibilities to be accepted. This is indeed an excellent section.

In chapter 9, the author presents his views on accuracy and economy of effort. The author feels that striving for a superlative and wholly unnecessary degree of accuracy in research work must require a great deal of effort, which

might otherwise be more profitably applied. By simple clear diagrams the author augments his discussion by visual aids. The young research worker could well devote the necessary time to a careful study of this chapter.

The subject of the minimum number of essential observations is discussed in chapter 10. In this material the author shows the importance of the statistical approach for ascertaining the minimum number of observation. Much of the discussion is illustrated by mathematical examples and graphs.

In Chapter 11, the author presents the problems of securing support for research work. Many of the differences in the methods used for financing research in universities, private laboratories, and industry are brought out.

The author carefully states in the preface and in many other sections of the text that the material was written for the benefit of young men and women entering the scientific-research field. Having read the book, the reviewer would place no such restriction on the text, as many parts of the text would prove interesting and valuable to experienced scientific-research workers. The book is, therefore, recommended for all persons interested in scientific research.

Books Received in Library

ACCEPTANCE SAMPLING, a Symposium. Published by American Statistical Association, 1108 16th St., N. W., Washington, D. C., 1950. Paper, 6 × 9¹/₄ in., 155 pp., diagrams, charts, tables, $1.50. This volume contains technical papers and discussions delivered at the 1946 annual meeting of the American Statistical Association. There are two papers on acceptance sampling by attributes and two papers on acceptance sampling by variables. Both prepared and impromptu discussions are included.

DATA ON CORROSION AND HEAT-RESISTANT STEELS AND ALLOYS—WROUGHT AND CAST. Sponsored by A.S.T.M. Committee A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys. (Special Technical Publication No. 52-A.) American Society for Testing Materials, Philadelphia, Pa., 1950. Paper, 6 × 9 in., 79 pp., charts, tables, $2.50. This publication brings up to date a previous compilation on wrought stainless alloys and includes a comprehensive new section devoted to cast alloys. It provides data on those stainless steels that have received the widest commercial usage. The data on the composition and properties of these chromium and chromium-nickel steels and alloy castings are in tabular form.

DROP FORGING. By H. Hayes. Second edition. Sir Isaac Pitman & Sons, London, England, 1950. Linen, 4 × 6³/₄ in., 105 pp., illus., diagrams, 6s. Relating mechanical with metallurgical problems, this book provides an introduction to the equipment and methods of the drop-forge shop, to the principles underlying drop forging, and to the heat-treatment and hammer treatment of forgings. The question of dies is also discussed.

EFFECTS OF ATOMIC WEAPONS, prepared for and in co-operation with the U. S. Department of Defense and the U. S. Atomic Energy Commission. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; and London, England, 1950. Linen, 6 × 9¹/₄ in., 456 pp., illus., diagrams, charts, tables, $3. Prepared under the direction of the Los Alamos Scientific Laboratory, this book summarizes present knowledge about the effect of atomic explosions. The nature of the explosion and its blast and radiation effects on people and property are considered in detail. Nuclear-radiation measurement, decontamination, and protection of personnel are also among the topics discussed.

HÄRTEREI-TECHNISCHE MITTEILUNGEN, Band 4, 1949. Edited by P. Riebensahm. Carl Hanser Verlag, Munich, Germany, 1950. Paper, 7 × 9¹/₂ in., 164 pp., illus., diagrams, charts, tables, 19.50 Dm. The nine papers in this volume were delivered at the fourth "Hardening" colloquium at Bremen and Stuttgart. They may be divided into four groups: (1) on basic problems of hardening, heat-treating and annealing; (2) on practical problems of heat-treatment; (3) on results of studies on the specific behavior of a steel during different heat-treating processes; and (4) on problems connected with strength determinations.

EVOLUTION OF SCIENTIFIC THOUGHT from Newton to Einstein. By A. d'Abro. Second edition, revised and enlarged. Dover Publications, New York, N. Y., 1950. Cloth, 5¹/₂ × 8¹/₄ in., 481 pp., illus., diagrams, $3.95. Written in nontechnical language, this book reviews the history of scientific thought from the establishment of classical physics down to the theory of relativity. The essential features of Newton's great discoveries, the classical theory of absolute space and time, the contribution of Riemann and its applications by Einstein are among the major topics considered.

GRUNDLAGEN DES WALZVERFAHRENS. (Stahleisen-Bücher, Band 9.) By H. Hoff and T. Dahl. Verlag Stahleisen, Düsseldorf, Germany, 1950. Cloth, 6¹/₂ × 9¹/₄ in., 295 pp., illus., diagrams, charts, tables, 29 Dm. Intended both as a text for the student and as a comprehensive reference for the mill engineer, this book considers the theory and practice of metal rolling. Following a survey of historical development, the casting of ingots is discussed. Steel, copper, aluminum, zinc, their alloys, and other metals which are forged and rolled are treated. Plasticity and the basic phenomena which occur during metal deformation are discussed prior to chapters on the rolling process, power and energy requirements in rolling mills, and rolling defects. An extensive bibliography is also included.

HEAT INSULATION. By G. B. Wilkes. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1950. Cloth, 5¹/₂ × 8³/₄ in., 224 pp., illus., diagrams, charts, tables, $4. This book is designed to bring together in one volume for the engineer, architect, and student some of the miscellaneous information on heat insulation which has previously been scattered through a variety of sources. In addition to the material on the fundamental formulas, types, purposes and economics of insulation and insulating materials, there are special chapters on reflective insulation, methods of determining heat-transfer coefficients, and factors affecting the coefficient of thermal conductivity. There is a bibliography.

HIGH-SPEED COMPUTING DEVICES. By the staff of Engineering Research Associates, Inc., supervised by C. B. Tompkins and J. H. Wakelin, edited by W. W. Stifler, Jr. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; and London, England, 1950. Cloth, 6 × 9¹/₄ in., 451 pp., diagrams, charts, tables, $6.50. This book is a discussion of the mechanical devices and electric circuits which can be incorporated into computing machines. It is not a detailed comparison of various machines although descriptions of certain American computers are given. The first part discusses the basic elements of machine computation. Part 2 is devoted to computing systems and part 3 to physical components and methods. References are placed at the end of each chapter and there is an extensive bibliography on punch-card computing systems.

HISTOIRE DE LA MÉCANIQUE. (Bibliothèque Scientifique 16.) By R. Dugas. Éditions Dunod, Paris, France. Éditions du Griffon, Neuchatel, Switzerland, 1950. Cloth, 6¹/₄ × 9 in., 649 pp., diagrams, tables, 5300 fr. Part 1 deals with the forerunners and pioneers of the field of mechanics, covering the important men, schools of thought, fields of activities, and developments from the Greeks and Arabs to the time of Kepler in the seventeenth century. The formulation of the classical mechanics during the seventeenth century is discussed in part 2, with parts 3 and 4 covering the organization and development that took place during the eighteenth and nineteenth centuries. Part 5 takes up the twentieth-century concepts: the relativity theory; quantum mechanics; wave mechanics; and the various developments of statistical mechanics.

HOCHOFENSCHLACKE. By F. Keil. Verlag Stahleisen, Düsseldorf, Germany, 1949. Cloth, 346 pp., illus., diagrams, charts, tables, 32.50 Dm. The primary interest in this book is for those who wish to utilize blast-furnace slag commercially. In a general section, various types of slags and slag formation are discussed briefly. Both slow-cooling and rapid-cooling blast-furnace slags are then treated in detail with emphasis given to their treatment and their commercial utilization in materials used for the construction of roads and buildings, rock wool, fertilizer, glass, and so on. An appendix covers various German official standards on the applications and testing of materials made from blast-furnace slags.

HYDRODYNAMICS, a Study in Logic, Fact, and Similitude. By G. Birkhoff. Princeton University Press, Princeton, N. J., 1950. Linen, 5¹/₂ × 8³/₄ in., 186 pp., illus., diagrams, charts, tables, $3.50. This book is devoted principally to two special aspects of fluid mechanics: (1) the complicated relation between theory and experiment, and (2) applications of symmetry concepts. Aspect (1) is dealt with in chapters 1 and 2 by an examination of the paradoxes of traditional hydrodynamics and a thorough consideration of "free boundary" theory. Concerning aspect (2), chapters 3 to 5 provide a treatment of "modeling" and dimensional analysis and various applications of group-theoretic ideas to fluid mechanics.

INDUSTRIAL INSTRUMENTATION. By D. P. Eckman. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London,

England, 1950. Cloth, $5^1/_2 \times 8^1/_2$ in., 396 pp., diagrams, charts, tables, $5. This book reviews the principles of the methods of measurement employed in industrial processing and manufacturing. Primary emphasis is given to the method rather than to the mechanism, and the fundamentals of physics pertaining to the problems of measurement are reviewed. Methods of applying instrumentation to processes are presented with the arrangement and selection of instruments, process analysis, and supervision of equipment. Mechanical, chemical, and electrical applications are covered, including spectrographic, strain-gage, and high-vacuum instrumentation.

INDUSTRIAL ORGANIZATION AND MANAGEMENT. By L. L. Bethel, F. S. Atwater, G. H. E. Smith, and H. A. Stackman, Jr. Second edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; and London, England, 1950. Linen, $6 \times 9^1/_4$ in., 851 pp., illus., diagrams, charts, tables, $5.50. This book is designed to provide a full and detailed understanding of the specialized activities of an industrial organization, large or small, their interrelationships, and the guiding principles used by management to co-ordinate and control them. In this second edition, new sections are included on production processes, waste control, plant and equipment maintenance, equipment replacement, and other matters dealing with principles o cost reduction. Case examples are extensively used throughout the book.

INELASTIC BEHAVIOR OF ENGINEERING MATERIALS AND STRUCTURES. By A. M. Freudenthal. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, Ltd., London, England, 1950. Cloth, $5^1/_2 \times 8^1/_2$ in., 587 pp., illus., diagrams, charts, tables, $7.50. This book provides a fundamental approach to the subject with main emphasis on the physical response of engineering materials to forces, time, and temperature. Following an examination of basic concepts, the structural and phenomenological framework of the theory of elasticity is developed. The remaining sections are devoted to selected problems of the mechanics of the inelastic continuum, to the design of engineering structures, and to mechanical testing.

INTEGRATED POWER SYSTEM. By P. Sporn. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; London, England, 1950. Linen, 157 pp., illus., diagrams, charts, maps, tables, $4. This book is intended to present the basic principles, economic advantages and disadvantages, and limitations of the integrated power system as the basic mechanism for power supply. The several chapters deal, respectively, with social-economic objectives, technical bases and requirements, components and tools, co-ordinating personnel, interconnections between systems, and economic problems. No detailed technical discussions are included, but an existing system is considered in the light of the principles set forth in the book.

LINEAR INTEGRAL EQUATIONS. By W. V. Lovitt. Dover Publications, New York, N. Y., 1950. Linen, $5^1/_2 \times 8^1/_4$ in., 253 pp., diagrams, tables, $3.50. The general theory of linear integral equations is presented in a systematic manner together with applications to differential equations, calculus of variations, and some problems in mathematical physics. The discussion is purposely confined to those equations which are linear and in which a single integration occurs. This edition is a reprint of a 1924 book which has been out of print for some time.

MECHANICS. By J. E. Boyd and P. W. Ott. Third edition. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; and London, England, 1950. Cloth, $6 \times 9^1/_4$ in., 422 pp., diagrams, charts, tables, $4.50. Emphasizing fundamental principles, this textbook focuses attention on the physical meaning of the operations involved in the solution of problems. In this third edition, additional material on machines and friction, graphical methods, forces in space, and kinetics is included. There is an expansion of the treatment of virtual work, including an elementary discussion of the stability of systems of one degree of freedom. In addition, new solved and unsolved problems are added.

METALS AT HIGH TEMPERATURES. By F. H. Clark. Reinhold Publishing Corporation, New York, N. Y., 1950. Linen, $6 \times 9^1/_4$ in., 372 pp., illus., diagrams, charts, tables, $7. This book is a compilation of the most recent available information on the properties of metals at elevated temperatures. It covers primarily heat-resistant alloys and special alloy steels but includes other metals as aluminum, lead, and magnesium alloys. An introductory chapter provides a theoretical discussion on the plasticity of metals with special reference to high-temperature effects. Manufacturing processes are briefly considered.

PETROLEUM PRODUCTION ENGINEERING, Petroleum Production Economics. By L. C. Uren. McGraw-Hill Book Co., Inc., New York, N. Y.; Toronto, Canada; and London, England, 1950. Cloth, $6 \times 9^1/_4$ in., 639 pp., charts, maps, tables, $7.50. Presented from the viewpoint of the practical engineer, this third volume of a three-volume set on petroleum production engineering provides an elementary exposition of the basic principles of economics and business administration as they apply to the petroleum and natural-gas industries. The economic geography of petroleum, oil, and gas-land acquisition and control, labor management, oil-industry taxation, cost accounting for oil production, and oil and gas conservation are some of the important topics covered. A selected bibliography follows each chapter.

PROPERTIES OF METALLIC MATERIALS AT LOW TEMPERATURES, volume 1. (Monographs on Metallic Materials). By P. L. Teed. John Wiley & Sons, Inc., New York, N. Y.; Chapman & Hall, London, England, 1950. Cloth, $5^1/_2 \times 8^3/_4$ in., 222 pp., illus., diagrams, charts, tables, $3.50; 21s. Serving as an introduction to the subject, this book is in the form of a critical survey of a large number of experiments. It begins with a review of related physical principles. Seven chapters are devoted to a consideration of some of the major mechanical properties at low temperatures of alloys of aluminum, iron, magnesium, copper, nickel, zinc, tin, and lead. Ferritic and austenitic steels are given special attention. A list of authorities consulted accompanies each chapter.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any item in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

ROLLING OF METALS, Theory and Experiment, volume 1. By L. R. Underwood. John Wiley & Sons, Inc., New York, N. Y., 1950. Cloth, $5^3/_4 \times 9$ in., 344 pp., illus., diagrams, charts, tables, $6.50. Based on a series of articles in *Sheet Metal Industries*, this book, volume 1 of a two-volume set, covers the fundamental aspects of the subject. It discusses forward slip, friction between the rolls and material, friction-hill theories of rolling, and methods of calculation of the rolling load based upon them. Simple cases are first dealt with, progressing through cases of added difficulty to the more complicated cases in which work-hardening, roll flattening, front tension, and back tension all occur together. There is a large classified bibliography.

SCHRAUBENHERSTELLUNG. (Stahleisen-Bücher, Band 4.) By E. Lickteig. Second edition. Verlag Stahleisen, Düsseldorf, Germany, 1950. Linen, $6^1/_2 \times 9^1/_4$ in., 244 pp., illus., diagrams, charts, tables, 26 Dm. This book provides a survey of the whole field of screw production. Following a historical development, the characteristics of screws are considered. Stress and fatigue requirements and examination and testing procedures are then discussed. A detailed account is given of current production practices, and special screws for use in corrosion and heat-resisting and nonmagnetic applications are also considered. There is a discussion of both European and American standards, and a review of patents is included. There is also a considerable bibliography.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly, to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

The following Case Interpretation was formulated at the Committee meeting September 22, 1950, and approved by the Board November 8, 1950.

CASE No. 1118

(*Interpretation of Pars. UG-84 or U-142*)

Inquiry: May carbon steel pipe, tubes, and forgings to meet the requirements of Pars. UG-84 or U-142, be furnished to meet the requirements of the appropriate material specification, except that the chemical requirements may be modified as follows:

Carbon	Max 0.25 per cent
Manganese	.. 1.10 .. ..
Phosphorus	.. 0.045 .. ..
Sulphur	.. 0.055 .. ..

Reply: It is the opinion of the Committee that material as described in the Inquiry, which meets the requirements of Specification SA-83, Grade A and also meets the impact requirements of the Code rules, for the intended low temperature service, may be considered as coming within the intent of the Code.

Cases Annuled

CASES 985, 1079, and 1080 are to be annuled when revisions to the Code, making the Case interpretations unnecessary, are adopted and published as addenda.

CASE No. 985 will be voided by the revision to Par. UG-41(b) published in the September, 1950, issue of MECHANICAL ENGINEERING.

CASE No. 1079, will be voided by adding a second sentence to the third paragraph of H-40. (See under "Revisions" for Low Pressure Heating Boilers.)

CASE No. 1080 will be voided by including Specification SA-299 in Table Q-5 under "P" Number 4—"O" Number 1. (See under "Revisions" for Welding Qualifications.)

Proposed Revisions and Addenda to Boiler Construction Code

AS need arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennally the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code. Simple changes are indicated directly. In the more involved revisions added words are printed in SMALL CAPITALS; deleted words are enclosed in brackets []. Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Power Boilers 1949

PAR. P-2. Add as sub-paragraph:

(f) Material covered by specifications in section II is not restricted as to the method of production unless so stated in the specification, and so long as the product complies with the requirements of the specification.

TABLE P-7. Transfer Specifications SA-229, SA-301, SA-302 and SA-315 with their stresses, putting SA-299 under Carbon Steel Plates, SA-301, SA-302 Grades A and B under Low-Alloy Steel Plates and SA-315 under Seamless Alloy Steel Pipe and Tubes.

PAR. P-333 (6) Delete and substitute:

(6) Scotch marine boilers—on either side of the shell near the normal water level line and within 24 in. of the front tube sheet. These stampings shall be left uncovered or an easily removable marked cover may be provided over the stamping when a boiler is covered with insulation or jacketed. No piping, boiler appliance, or other obstructions shall interfere with the reading of the stamping.

PAR. A-26. Revise last sentence to read:

The pressure part shall not have been subject to a pressure greater than twice the designed maximum working pressure prior to making the proof hydrostatic test.

Low-Pressure Heating Boilers 1949

PREAMBLE. Delete and substitute:

These rules are divided into two sections: Part I applying to steel plate boilers, and Part II applying to cast iron boilers. They do not apply to economizers or feedwater heaters. They were not formulated to cover apparatus such as ordinary range water backs, range boilers, or service water heaters, either oil, gas, or electrically heated and used for the production of service hot water supply, or coil or tubular type water heaters without integral water storage capacity used for the same service.

For the purposes of these rules, a range boiler is a ferrous or non-ferrous tank with nominal cubical capacity of 120 gallons or less for the storage of water at pressures not in excess of the maximum working pressure marked thereon, at temperatures not in excess of 200 F and having no self-contained means of heating. A service water heater is a range boiler or tank with a self-contained gas or oil burner or electric heater having an hourly heat input of less than 100,000 Btu and a nominal water containing capacity of 120 gallons or less and used exclusively for the heating of service water not in excess of 200 F.

To prevent pressures in excess of the maximum allowable pressure due to the application of heat, it is recommended that all vessels used for storing hot water be provided with safety devices.

The code does not contain rules to cover all details of design and construction. Where complete details are not given, it is intended that the manufacturer, subject to the approval of the authorized inspector, shall provide details of design and construction which will be as safe as otherwise provided in these rules.

PAR. H-40 Add to third paragraph:

For boilers with a normal grate line, the recommended pipe sizes are tabulated in Fig. H-3. For boilers which do not have a normal grate line, the recommended pipe size is $1^1/_2$ in. for boilers with minimum safety valve relieving capacity 250 lb per hour or less, $2^1/_2$ in. for boilers with minimum safety valve relieving capacity from 251 lb to 2000 lb per hour, inclusive, and 4 in. for boilers with more than 2000 lb per hour minimum safety valve relieving capacity.

Unfired Pressure Vessels 1949

TABLE U-4 Remove stresses for SA-53, Grades A and B, under heading Seamless Carbon Steel and insert them under heading Electric Resistance Welded-Carbon Steel.

Unfired Pressure Vessels 1950

TABLE OF CONTENTS. Change title of Appendix L to: "Examples Illustrating Application of Code Formulas and Rules."

PAR. UG-5. Add as subparagraph.

(b) Material covered by specifications in Section II is not restricted as to the method of production unless so stated in the specification, and so long as the product complies with the requirements of the specification.

PAR. UG-45(c) (d) and (e). Change "separate inspection openings" to "openings for inspection only."

PAR. UG-101(c). Replace with:

(c) The pressure part shall not have been subject to a pressure greater than twice the designed maximum working pressure, adjusted or operating temperature, as described in Par. UG-99(b) prior to making the proof hydrostatic test.

FIG. UW-9. Letter the three sketches "(a)," "(b)," and "(c)."

PAR. UW-14(b). In second line change "Par. UG-36(c)" to "Par. UG-36(c) (2)."

REVISE Fig. UW-15. Revise sketch (d) at (6) to agree with Fig. U-10, 1949 edition. Just below middle of page change "alternate" to "alternative." In right hand sketch of bottom row at (5) insert dimension "t_2."

PAR. UA-47(c) Below formula for W, after "atmospheric temperature conditions," insert "(See note 4.)"

PAR. UA-49(a)(1), page 180. In fourth line change "(8c)" to "(8b)."

PAR. UA-50(a) In third line change "(See note 6)" to "(See note 5)." At end of paragraph (a) change "Note 6" to "Note 5."

Announcement

Alloys M1A and MG11A of ASTM Specification B-210, have been approved for use in unfired pressure vessels.

THE ENGINEERING PROFESSION

News and Notes

As Compiled and Edited by A. F. Bochenek

Critical Shortage of Engineers Developing From Low Engineering Enrollments

30 to 60 Per Cent Annual Deficit Estimated

UNLESS a "realistic draft policy" is developed soon to conserve the dwindling supply of engineering graduates, the nation will be faced with an annual deficit of engineers after June, 1951, of from 30 to 60 per cent, based on an estimated annual minimum need of 30,000 engineering graduates.

This warning was made by S. G. Hollister, dean, College of Engineering, Cornell University, at the 18th Annual Meeting of the Engineers' Council for Professional Development, Cleveland, Ohio, Oct. 20–21, 1950.

Dean Hollister's statement follows:

Engineering college administrators have been concerned since last spring over the reduction in freshman enrollment in engineering. Evidence of its critical nature became apparent in July in many parts of the country. The extent of the trouble could not be gaged, however, until actual matriculation in the fall.

On behalf of the Man Power Committee of the American Society for Engineering Education, the writer undertook a survey of freshman enrollment as of Oct. 1, 1950. For this purpose 34 institutions were selected, classified as to type and location as follows:

Technical schools	9
Universities	21
State colleges	4
Co-operative schools	2
Publicly supported	23
Privately supported	11
Denominational	2
Urban	17
Rural	17
New England States	2
Middle Atlantic States	9
Southeastern States	4
Southcentral States	1
Southwestern States	3
Northcentral States	13
Mountain States	1
Pacific States	1

Enrollment of freshmen at this group of institutions during the past three years was of the order of half that for the entire country. Moreover, there appeared to be a fairly consistent relation between the enrollment for the group and that for all schools. It thus appeared reasonable to use the current enrollment of freshmen by this group as a basis of estimating the enrollment of freshmen throughout the country.

Table 1 gives the result of the survey. Figures for previous years were taken from ASEE data published each year in the ASEE Yearbook or the Proceedings.

In making the estimate of current enrollment of freshmen of 26,500, consideration was given to the increase in percentage of freshmen enrolled in the sample group as the total enrollment was reduced from 1947 onward.

The number of high-school graduates in the same years and the percentages enrolling in engineering courses are given in Table 2.

In the immediate future years there will be a gradual decrease in high-school graduates totaling 10 per cent by 1953, after which the present number will be reached again by 1958.

An estimate was made of total enrollment based on an analysis of the published data on classes for the preceding two years. This resulted in an estimate of over-all undergraduate enrollment of 130,000.

The engineering profession needs about 20,000 engineering graduates annually for civilian peacetime needs alone. The present emergency will convert many of the peacetime needs to emergency needs of industry; and in addition the military needs are to be added to civilian requirements. It is estimated that a minimum of 30,000 graduates from engineering schools will be required each year to supply the total needs.

TABLE 1 FRESHMAN ENROLLMENT 1940–1950

Freshman enrollment	1940	1947	1948	1949	1950
34 Institutions	16,407	27,124	22,735	19,189	14,057
Entire country	33,175	57,507	47,672	36,508	26,500*
Former as per cent of latter	49.5	47.2	47.7	52.4	53.0

* Estimated

TABLE 2 HIGH-SCHOOL GRADUATES 1940–1950

Year	1940	1947	1948	1949	1950
High school grads. (millions)	1.22	1.08	1.19	1.27	1.23
Per cent to engineering	2.7	5.3	4.0	2.9	2.2

ASME MANAGEMENT DIVISION MARKS PUBLICATION OF "SMALL PLANT MANAGEMENT" AT A LUNCHEON FOR AUTHORS GIVEN BY MCGRAW-HILL BOOK COMPANY, SEPT. 29, 1950

(*Left to right:* Lillian M. Gilbreth, Edward H. Hempel, editor; Curtis Benjamin, president, McGraw-Hill Book Company, and H. V. Coes. Twenty members of the ASME Management Division, each a nationally recognized authority in his field have pooled their knowledge and experience to make possible publication of a 548-page guide to modern management techniques. A review appears on pages 926–927 of the November issue of Mechanical Engineering.)

The total undergraduate enrollment in 1948 was 226,000 and in 1949, 181,000. The decreases in total enrollment to the present estimated 130,000 are 42 and 28 per cent respectively. The present total is still 20 per cent above the 108,000 of 1940 but that figure will be reached in another year if the freshman enrollment is no larger next year. If this size of entering class were to continue, the total enrollment would drop below 90,000.

Assuming that Selective Service were not withdrawing students from the engineering schools, the graduating classes in the next four years are estimated as follows: 1951, 32,500; 1952, 21,900; 1953, 17,000; 1954, 12,400. It is thus seen that if the draft were not calling engineering students, and all who were academically successful were allowed to continue, after next June there would be an annual deficit of from 30 to 60 per cent based on 30,000 minimum need.

The Selective Service System announced on Oct. 6, 1950, a plan being promulgated by their technical advisory committees and which the director stated he was prepared to support, whereby those students who completed the freshman class in the upper half would be allowed to continue, those in the upper two thirds of the sophomore class would be allowed to proceed; and those in the upper three quarters of the junior class could continue. Assuming that the entire freshmen ranged from 16 to 19 years, the number to graduate from each 100 freshmen is estimated to be 34. Applying these rates to the present enrollments, it is found that the graduations in 1952 would be 18,000, and in 1954 only 9000.

It is the writer's belief that in view of the fact that industry has absorbed nearly 50,000 graduates this year, the estimate of a combined annual need for both industry and the armed forces of 30,000 is conservative. It appears, therefore, in the national interest to assure the country of a continuing supply of at least 30,000 graduates. To achieve this objective it is first of all essential to develop a realistic draft policy.

In view of the recently proposed regulations this matter is very urgent. Regulations that will conserve the present dwindling supply are necessary.

A second step toward this objective is the stimulation of a greater interest among high-school students in the study of engineering. Tables 1 and 2 show a dwindling percentage of high-school students entering engineering schools. This has no doubt been due to unfortunately adverse publicity concerning anticipated excess supply of engineers which has not materialized. In view of the fact that for nearly a decade there will be no increase in high-school graduates, it will be necessary in the national interest to attract a greater percentage of them to engineering.

ECPD Program Revitalized

1950 Annual Meeting at Cleveland Considers Important Projects

UNDER the leadership of the chairman, Dr. Harry S. Rogers, president, Polytechnic Institute of Brooklyn, the Engineers' Council for Professional Development made substantial progress toward a revitalization of its program at the eighteenth annual meeting held at the Tudor Arms Hotel, Cleveland, Ohio, on Oct. 20-21, 1950, with an attendance of 174 members and guests.

A. R. Hellwarth Luncheon Speaker

The meeting opened at noon on October 20 with a luncheon at which L. F. Grant, vice-chairman, ECPD, associate professor, Queen's University and Royal Military College, Kingston, Ont., Canada, presided. A. R. Hellwarth, assistant to employment-manager, The Detroit Edison Company, spoke immediately following the luncheon, on the topic, "Relationship of Guidance to an Industry Recruiting Program."

Mr. Hellwarth said that industry invests at least $10,000 and two years of irreplaceable time before a newly recruited engineer is able to accept the full responsibility of a job in a modern industrial organization. Career counseling given wisely and early may reduce the number of men who fail to measure up during the training period and will help "industry save time, money, and bring happiness rather than disappointment to the potential employee." He recommended use of the term "career planning" instead of "guidance," stating that the primary responsibility for selecting a proper career is with the individual himself. He discussed factors that affect career planning at various age levels—high school and college—and suggested ways in which the effectiveness of counseling might be improved. In reference to tests used for vocational-guidance purposes, Mr. Hellwarth spoke of the cost involved and the availability of qualified persons to give and interpret them. "Caution should be exercised in using tests properly," he asserted. "Tests are helpful, but should be thought of as another tool or aid to effective career planning." He closed his address with reference to the development of tests to discover latent "human relations" ability in individuals. Some work has been done in this field by The Detroit Edison Company, he reported, but complete details are not ready for publication.

Reports of Committees

Reports of ECPD Committees were presented, discussed, and approved at sessions held on the afternoon of October 20 and the morning and afternoon of October 21. Dr. Rogers presided at these sessions. Preprints of committee reports were available for the first time in the form of a printed pamphlet. Early publication of the complete revised reports is expected.

Z. G. Deutsch presented the report of the Committee on Student Selection and Guidance and discussed two principal phases of the Committee's activity: (1) The preparation of a guidance manual, publication of which has been postponed; and (2) planning for research for future guidance materials, which included conversations on "an appropriate method of gathering factual data on the relationship between success in the practice of engineering and success in absorbing the formal studies leading to an engineering career."

Ernest Hartford reported on the results of a study of local guidance projects being conducted throughout the United States which showed a considerable number of projects, a diversity of method, and a wide variety of organizations acting as sponsors.

In reporting for the Committee on Engineering Schools, S. C. Hollister reviewed the accreditation activities of the past year. He asked for and received approval of a statement in "Differentiating Characteristics of an Engineering Curriculum" (see MECHANICAL ENGINEERING, February, 1950, pages 122-123) which attempts to clarify the policies to be followed in deciding whether a curriculum, in geology, say, is an engineering curriculum, and offers a definition of engineering. This statement will appear with the final printing of the Committee report. He spoke briefly of the work of the Subcommittee on Graduate Education and the Subcommittee on Technical Institutes. By far the greatest amount of interest was aroused by a subject introduced by Dean Hollister that was not mentioned in the Committee report. This was a statement regarding the declining enrollment in high schools and in engineering colleges. The text of this statement appears on the preceding page.

For the Committee on Professional Recognition, R. H. Barclay reported on current activities and on the status of the recommendations on uniform grades of membership which were put forward a year ago and referred to the constituent societies of ECPD for adoption.

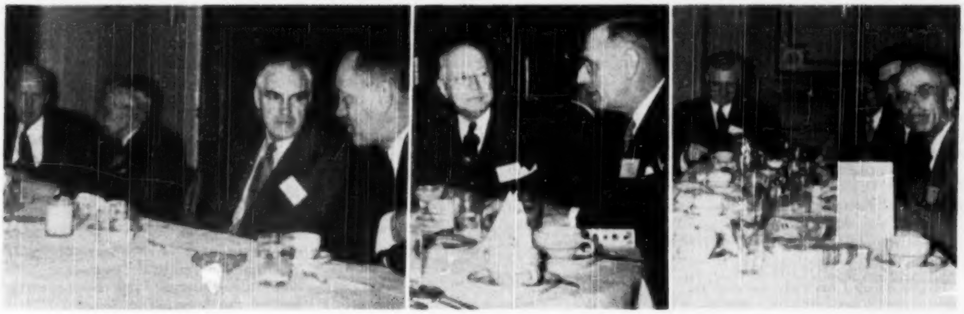
The brief report of the Committee on Information included a statement to the effect that gross income from the sale of ECPD publications "was $12,500, or more than twice what it was last year."

William F. Ryan presented the report of the Committee on Engineering Ethics which summarized progress in the adoption by constituent and other societies of the Canons of Ethics for Engineers. "Sixty-five engineering societies have now adopted the Canons," he reported, "and 13 societies have endorsed them without, however, superseding previously adopted codes."

Brief reports of the representatives of the constituent organizations were also presented, as well as a report by Ralph Goetzenberger on the Citizens Federal Committee on Education.

Annual Dinner Addressed by Rogers and Walters

The annual dinner of the Council and its guests, which was preceded by a reception, was held on Friday evening, October 20. Colonel Grant presided and introduced past-chairmen of ECPD and presidents of the participating societies present, as well as representatives of Cleveland engineering groups. Dr. Rogers paid tribute to the late Robert E. Doherty, former chairman of ECPD, news of whose death had just been received. He gave the substance of his annual report as chairman of



AT THE 1950 ECPD ANNUAL MEETING HELD IN CLEVELAND, OHIO, OCT. 20–21, 1950

(*Left to right:* Tell Berna, general manager, National Machine Tool Builders' Association, Cleveland, Ohio; L. F. Grant, vice-chairman, ECPD, field secretary EIC; Elmer Hutchisson, acting president, Case Institute of Technology, Cleveland, Ohio; W. J. W. Reid, president, Otis Elevator Company, Ltd., Hamilton, Ontario, Canada; R. H. Barclay, J. G. White Engineering Corporation, New York, N. Y.; M. S. Coover, professor of electrical engineering, Iowa State College, Ames, Iowa; C. E. Davies, secretary ECPD; Frank C. Tolles, consulting engineer, Cleveland, Ohio, F. J. Van Antwerpen, editor, *Chemical Engineering;* and Stephen L. Tyler, secretary, AIChE.)

ECPD (see pages 895–896 of the November issue of MECHANICAL ENGINEERING) in which he strongly recommended "that we define our undertakings more clearly and specifically; that the programs of our committees have sharper focus and continuity; and that we organize internally and co-operatively to produce more tangible and constructive achievements."

Speaking on the topic, "Relationship of Engineering Education to the Profession and Industry in the Community," Raymond Walters, president of the University of Cincinnati, said that military preparedness will have an immediate and devastating effect on higher education in America if present proposals are carried through.

"The President's call for 3,000,000 men by the fall of 1951," he said, "may prove to be as serious to higher education as total mobilization in World War II, since the draft is to be of the younger men 19 to 26 years of age. Population within these younger age groups is diminished, because of the low birth rate during the 1930's, and by the exemption of veterans and men with dependents." This, he claimed, will result in an increased demand for the college-age youth. He quoted U. S. Commissioner of Education McGrath as saying: "The kind of personnel needed for military duty—young, intelligent, able-bodied men—must be drawn from the age groups normally found in institutions of higher education."

According to President Walters, another danger for engineering education especially, is in the present selective service thinking on students in higher education. The proposals call for a superior scholastic record in high school and college. In the face of heavy demands in industry for engineers, the prospects of insuring an adequate supply of engineering students is woeful. The entire crop of 50,000 June graduates in engineering have already been absorbed by industry, and this represented an all-time graduation peak for this field. According to a survey made by President Walters, 75 per cent of over 500 approved colleges and schools have already shown sizable decreases in full-time students compared with a year ago. Engineering colleges show heavier losses than other types of colleges, both in full-time students and in freshmen.

He claimed that part of the decrease was due to a Department of Labor report which indicated the field of engineering to be overcrowded. The facts are that if 50 per cent of the freshman classes in engineering schools graduate this fall, it will supply barely 17,000 engineers compared to 50,000 total placed this year. Since only 2.4 of high-school graduates are now going to college for engineering courses, and 5 per cent of the high-school graduates are needed to sustain the supply for such personnel, the Selective Service proposals, if adopted, would mean a drop of one quarter of the entering number.

This, according to the speaker, concerned the entire nation. "The mass production of America and its consequent high standard of living depends on the training of the engineering institutions of a large number of high-grade engineers," he concluded.

First Five Years of Professional Development

Possibly the most stimulating evidence of a revitalized program for ECPD was found in the presentation on Saturday morning, October 21, of the report of the Committee on Professional Training. A six-point program was presented by A. C. Monteith, chairman of the Committee, with the assistance of the chairmen of the six subcommittees to which were assigned the six parts of the proposed program. These presentations covered work done by the subcommittees during the year and are recorded in a voluminous report, "The First Five Years of Professional Development," which has been circulated among the constituent societies in order to stimulate interest and support of an ambitious but fruitful project for the benefit of young engineers during the difficult period immediately following graduation. This report shows how employers can organize orientation and training programs; how employers, schools, and engineering societies can team up for training jobs that none of them can adequately accomplish alone; how engineering societies through local sections can direct the energy of young graduates into community projects; how legal registration is a means but not an end to professional development; and how the societies, colleges, and employers can encourage wider use of self-appraisal aids among young engineers.

With Mr. Monteith providing introductory explanation of the over-all program, introducing each feature of it with appropriate remarks, and finally summing up the significance of the proposed activity, the six principal features of the program were presented in brief informative style as follows:

Orientation and Training of the Young Engineer in Industry, by H. K. Breckenridge of the West Penn Power Company.

The Continued Education of the Graduate Engineer, by J. C. McKeon of the Westinghouse Electric Company.

Integrating the Young Engineer Into His Community, by Karl B. McEachron, Jr., of the General Electric Company.

Registration of the Young Engineer, by H. B. Solberg of Purdue University.

Self-Appraisal Methods for Valuable Characteristics in Engineering, by Frank N. Entwistle of Newark College of Engineering (speaking for the chairman of that subcommittee, Allan R. Cullimore, who was not present).

Reading Lists, by Don P. Reynolds, American Society of Civil Engineers.

It is hoped that the substance of these excellent presentations will be available for publication in a later issue.

Mr. Monteith distributed copies of a brochure in which the program of the Committee is briefly described, the suggested method of implementation is outlined, and an appeal for financial support is presented. It was explained that approval of the project by two thirds of the constituent societies of ECPD will be required before the program can be put into effect, and it is confidently expected that this approval will be forthcoming as soon as all of the societies have had an opportunity to act on the proposal. The plan involves the hiring of a full-time field secretary qualified to administer it on behalf of ECPD under the guidance of the Committee. A number of com-

munities in which the plan is needed and would have reasonable assurance of support and success would be chosen. The field secretary would study the local needs and conditions and assist the engineering society, industrial organizations, and educational institutions in each area, and initiate projects which eventually would be carried on with local talent and support for the benefit of the community.

It was pointed out that the proposal of the Committee is, in effect, one that was suggested by Gen. R. I. Rees, the first chairman of the Committee, and that the present Committee had taken up the work interrupted by General Rees' death.

Engineering Curricula Accredited

At an executive session of the Council held on the evening of October 20, 244 engineering curriculums and 30 programs of the technical-institute type were accredited on recommendation of the Committee on Engineering Schools. The full list of accredited curriculums and programs will appear in the forthcoming annual report.

Revised Charter Approved

At a luncheon on Saturday noon, October 21, at which Colonel Grant presided, Tell Berna, general manager, National Machine Tool Builders Association, spoke on the topic, "The Place of the Engineer in Industry."

Following the luncheon, with Dr. Rogers in the chair, the Council held its concluding session. S. D. Kirkpatrick presented the report of the ECPD Committee on Unity. W. A. Carter, chairman of the Committee on Charter Revision, presented a revised charter which follows in substance the present charter but is more specific as to wording in certain parts. The Council approved the revision after discussion and forwarded it to the constituent societies for adoption. Until the revised charter is formally adopted, the present charter will be in force.

A revision of the Rules of Procedure was also presented by Mr. Carter and discussed by the Council. Certain changes in wording were suggested and the amended Rules were adopted and are now in force. Aside from rewording to make certain rules more definitive, the principal changes introduced under the new rules relate to the committees of the Council. The original four standing committees are now called Guidance Committee, Education Committee, Training Committee, and Recognition Committee. A new committee to cover a portion of the activity under the former Committee on Engineering Schools (now the Education Committee) is added in the new Rules and is called the Student Development Committee. Two formerly special committees, the Committee on the Principles of Engineering Ethics, and the Committee on Information, become standing committees under the new Rules and are known as Ethics Committee and Information Committee, respectively.

A resolution of thanks was adopted which paid special tribute to Frank C. Tolles who was in charge of local arrangements for the Cleveland meeting.

Election of Officers

The following officers were unanimously elected: Harry S. Rogers, chairman; L. F. Grant, vice-chairman; W. H. Carey, secretary; E. H. Robie, assistant secretary. The Executive Committee for the year 1950–1951 will consist of the officers and V. T. Boughton (ASCE), C. E. Lawall (AIME), Guy R. Cowing (ASME), M. D. Hooven (AIEE), L. F. Grant (EIC), C. G. Kirkbride (AIChE), Thorndike Saville (ASEE), and C. S. Crouse (NCSBEE). Chairmen of the standing committees elected are: W. F. Thompson (Guidance), S. C. Hollister (Education), A. C. Monteith (Training), R. H. Barclay (Recognition), W. F. Ryan (Ethics), and Walter E. Jessup (Information). K. L. Holderman replaces H. P. Hammond as chairman of the Committee on Technical Institute Programs. Representatives of ASME on the Council for 1950–1951 are Guy R. Cowing, William F. Ryan, and A. C. Monteith.—G.A.S.

UNESCO Recruiting Teams of Specialists

THE Technical Assistance Service of UNESCO (United Nations Educational, Scientific and Cultural Organization) is seeking help of national commissions of UNESCO member states in recruiting technical specialists for its educational and scientific projects authorized for 12 countries in Asia, North and South America, and Africa. These projects, totaling $1,000,000, were authorized as part of the United Nations technical-assistance program for underdeveloped areas.

According to Malcom S. Adiseshiah, a native of India, who heads the Technical Assistance Service, technical specialists are needed to serve on teams which UNESCO is now readying for the field. A number of selections already having been made. Men and women already selected having high professional standing, have been able to arrange leave from regular jobs with universities or industry, and have had an interest and knowledge of the country to which they are being sent.

Funds have been allocated to Ceylon, Ecuador, India, Indonesia, Iraq, Lebanon, Liberia, Libia, Mexico, Pakistan, Iran, and Thailand. All projects had been drawn up on specific requests of the recipient governments; are subject to review by the UN Technical Assistance Board, and must contribute to economic development or social problems related to such development.

Further requests for UNESCO assistance are now being considered from Egypt, the Philippines, Burma, Israel, Guatemala, Colombia, El Salvador, and British and French nonself-governing territories.

The U. S. National Commission for UNESCO was established by law to advise the Department of State on UNESCO affairs and has the major responsibility for UNESCO programs in this country. The U. S. National Commission is composed of 100 members. Sixty of these represent national organizations including the Engineers Joint Council, and the others are selected as individual leaders from many fields.

R. M. Gates, Fellow and past-president ASME, as EJC representative is spokesman for American engineers on the Commission. George D. Stoddard, president, University of Illinois, is president. The three vice-chairmen are Detlev Bronk, president, The Johns Hopkins University; Erwin D. Canham, editor, *Christian Science Monitor;* and Mrs. Henry Potter Russell, San Francisco civic leader.

UET Continues Search for New Engineering Building

THE Carnegie ideal of unity of the engineering profession through ownership and occupancy of an engineering center as exemplified in the Engineering Societies Building, New York, N. Y., is receiving much attention from the Real Estate Committee of the United Engineering Trustees, Inc.

The UET Committee is looking for a new building large enough to accommodate all engineering societies who would care to establish offices under one roof. The ideal building would have sufficient meeting and conference facilities to serve as a national center of engineering.

The UET, a corporation formed by the Founder Societies (ASCE, AIME, ASME, and AIEE) to operate the Engineering Societies Building, report that while the "fortresslike shell" of the present building is in excellent condition, serious weak spots exist in such items subject to mechanical wear as windows, doors, elevators, and chairs in meeting rooms and auditorium. Recent surveys have shown that needed repairs would absorb much of the building depreciation fund accumulated over the years.

The most serious deficiency of the 43-year-old building, however, is its functional obsolescence. The marble halls and monumental stairways are wasteful of space and costly to clean, light, and heat. The limited space facilities have forced the ASME and one other founder society to rent additional space for staff in nearby buildings.

During the past year the UET Real Estate Committee has been discussing the housing problem with "influential men whose background was engineering" or who were "close enough to engineering to make them sympathetic to the advantage of bringing the increasing number of professional societies under one roof."

The Committee has explored various existing buildings as a temporary solution to the space shortage. Consideration was given to an invitation from the Carnegie Endowment for International Peace to use part of a proposed building planned for the United Nations area, but analysis of costs showed that such a move would be prohibitive. The Committee's experience to date indicates that the only acceptable solution to the building problem is a new building which could encourage unity among the various engineering societies and could become a national engineering center.

Interest in the present building by prospective buyers is such that no difficulty should be experienced in selling it, according to the Committee. The property is currently valued at $935,000, of which $430,000 is for land and $505,000 for building.

National Science Foundation Board Announced by President Truman

TWENTY-FOUR engineers, industrialists, and educators were appointed recently by President Harry S. Truman to the Board of the National Science Foundation which was authorized by the bill signed by the President on May 10, 1950. Members of the newly appointed Board are drawn from 16 states and the District of Columbia. Seven are university presidents, three college deans, three college department heads, four university professors, two research directors, two presidents of public-affairs foundations, two industrial-corporation presidents, and one a consulting engineer.

Three of the appointees are among the 24 engineers recommended to the President by the Engineers Joint Council as qualified to serve on the board when passage of the National Science Foundation Bill was imminent. Two members and one Fellow of The American Society of Mechanical Engineers are on the Board.

Members of the Board

Members of the Board follow: Sophie D. Aberle, special research director, University of New Mexico, Albuquerque, N. Mex.; Robert Percy Barnes, head of department of chemistry, Howard University, Washington, D. C.; Chester I. Barnard, president, Rockefeller Foundation, New York, N. Y.; Detlev Wulf Bronk, president, The Johns Hopkins University, Baltimore, Md.; Gerti Theresa Cori, professor of biological chemistry, Washington University Medical School, St. Louis, Mo.; James Bryant Conant, president, Harvard University, Cambridge, Mass.; John W. Davis, president, West Virginia State College, Institute, W. Va.; Charles Dollard, president, Carnegie Corporation, New York, N. Y.; Lee A. Dubridge, president, California Institute of Technology, Pasadena, Calif.; Edwin B. Fred, president, University of Wisconsin, Madison, Wis.; Dr. Paul M. Gross, dean, Duke University Graduate School, Durham, N. C.; George D. Humphrey, president, University of Wyoming, Laramie, Wyo.; O. W. Hyman, dean, Medical School, and vice-president, University of Tennessee, Knoxville, Tenn.; Robert F. Loeb, Bard Professor of Medical Services, College of Physicians and Surgeons, Columbia University, New York, N. Y.; Donald H. McLaughlin, president, Homestake Mining Company, San Francisco, Calif.; Frederick A. Middlebush, president, University of Missouri, Columbia, Mo.; Edward L. Moreland, Mem. ASME, Jackson and Moreland, consulting engineers, Boston, Mass.; Joseph C. Morris, head of physics department and vice-president, Tulane University, New Orleans, La.; Harold Marston Morse, professor of mathematics, Princeton University, Princeton, N. J.; Andrey A. Potter, Fellow ASME, dean of engineering, Purdue University, Lafayette, Ind.; James A. Reyniers, director, Bacteriology Laboratories, Notre Dame University, South Bend, Ind.; Elvin C. Stakman, chief, division of plant pathology and botany, University of Minnesota, Minneapolis, Minn.; Charles Edward Wilson, Mem. ASME, president, General Electric Company, Schenectady, N. Y.; and Patrick Henry Yancey, professor of biology, Spring Hill College, Spring Hill, Ala.

NSF Objectives

One of the first tasks of the board will be to elect its own chairman. Among the objectives of the National Science Foundation are the following: (1) To develop and encourage the pursuit of a national policy for promotion of basic research and education in the sciences; (2) initiate and support basic scientific research in the mathematical, physical, medical, biological, engineering, and other sciences; (3) at the request of the Secretary of Defence to support research relating to national defense; (4) award scholarships and graduate fellowships in engineering and other sciences; (5) foster interchange of scientific information among scientists in the United States and foreign countries; (6) evaluate and correlate any research programs undertaken by other agencies of the Federal Government; (7) establish special commissions if necessary to carry on its functions; and (8) maintain a register of scientific and technical personnel, and to serve as a clearinghouse for this information in the United States and its territories and possessions.

The Act provides for an appropriation of $500,000 for 1950 and a sum not to exceed $15,000,000 for each fiscal year thereafter.

Results Announced on Fair Day's Work Research

SOME 2800 feet of motion film showing 24 industrial, clerical, and laboratory operations, each at five different speeds, are now available to industrial and business firms to assist them in determining just what is a fair day's work, it was announced recently by H. K. Work, director, research division, College of Engineering, New York University, New York, N. Y.

These films, Dr. Work said, are the product of the first phase of a research program which has been in progress at NYU under the direction of Herbert A. Lynch, Jr., for the past several years. The program is sponsored by the Committee on Rating of Time Studies of the Society for the Advancement of Management.

These 120 separate performances were viewed by more than 1800 engineers in more than 200 industrial companies throughout the country, Dr. Work explained. The observers' ratings, some 150,000 in number, he added, constitute the data on which findings have been based.

Films are 16 mm, silent, black and white. Reels have an average length of 350 ft. The manual which accompanies the films is divided into eight sections having the following headings:

How the time values were developed; description of the 24 operations; how to convert the time values into ratings for your system of time study; time values; speed control of projectors; rating errors; methods variations; and how to use films and time values."

Price of films and manuals is $495. Orders should be sent to Prof. D. B. Porter, College of Engineering, New York University, New York 53, N. Y.

No rental films are available and only complete sets will be sold. Income realized from sales will go for further research in work measurement.

Progress Reported in Anti-Air Pollution Program

DURING the 1950 Great Lakes operating season an intensive anti-air-pollution program has been carried on by the Lake Carriers Association, Bituminous Coal Research, Inc., and the Coal Producers Committee for Smoke Abatement.

Also co-operating in the program was the Air Pollution and Smoke Prevention Association of America.

The program was organized in three phases. First, the Lake Carriers Association and the coal producers arrived at an agreement on fuel specifications. In the second phase, operation of hand-fired and mechanically fired equipment on Great Lakes vessels was observed. Two survey engineers were placed on every vessel to be studied. Their function was not to attempt to correct any bad practices in firing or in adjustment of instruments or equipment out of condition but rather to catalog operational mistakes and equipment difficulties so that an over-all picture could emerge upon which to base recommendations for correction.

The final phase of the project now under way is a co-operative study conducted by equipment manufacturers and an Engineering Advisory Committee composed of representatives of the co-operating agencies. Out of this study will come a solution to the problem of excessive smoke emittance from mechanically equipped vessels.

Based on the information collected during the summer, it is expected that an elaborate educational program for operating personnel will be developed. This will consist of schools for operators and management. A new manual of instructions for use on shipboard will also be issued. It is expected that lectures will be recorded on wire tape.

During the winter lay-up period, any revisions and repairs to equipment and controls recommended by the survey engineers during the observation period will be made.

Members of the Engineering Advisory Committee are: Lyndon Spencer, Lake Carriers Association, chairman; M. E. Kingsbury, Fleet Engineers Committee, Lake Carriers Association; R. C. Stanbrook, Mem. ASME, Fleet Engineers Committee, Lake Carriers Association; E. D. Benton, Mem. ASME, Bituminous Coal Research Industrial Utilization Committee and Ohio Coal Association; E. C. Payne, Mem. ASME, BCR Motive Power Committee and Pittsburg Consolidation Coal Company; Elmer R. Kaiser, Mem. ASME, assistant director of research, BCR; and H. B. Lammers, Mem. ASME, chairman, Coal Producers Committee for Smoke Abatement.

All Phases of Registration Reviewed at NCSBEE Annual Meeting

Russell G. Warner Elected President for 1951

THE National Council of State Boards of Engineering Examiners held its 29th Annual Meeting at the Congress Hotel, Chicago, Ill., Oct. 9–11, 1950.

The meeting consisted of business sessions, group meetings of delegates from zones of the National Council, and meetings of all the standing committees. A fellowship party during the first day and the annual banquet on the following day provided enjoyable social interludes.

As main speaker at the banquet, N. W. Dougherty, chairman, Tennessee State Board of Architectural and Engineering Examiners, reviewed the history and accomplishments of the Council. Engineering registration, he said, was of comparatively recent origin. In the United States it began with the passage of a law in Wyoming in 1907 and was completed when the District of Columbia passed its registration law in 1950.

History of Council Reviewed

Referring to the Council itself, Mr. Dougherty explained that it was formed for free discussion and the exchange of ideas. None of its acts or recommendations were binding on any of the boards because these boards were autonomous and were required to act under the laws of their own state and were not permitted to delegate any of their functions to other agencies. "Boards can," he continued, "use information and procedures suggested by other boards; they can co-operate with each other in gathering information, in exchanging ideas, and in getting uniformity.

The Council is not a union whose majority action is binding on all the members; it is a loosely knit association for the benefit of all its members."

Uniformity of the state registration laws, Mr. Dougherty stated, was one of the problems discussed at the first meeting of the Council nearly 30 years ago. Uniformity was still a problem today. Lack of uniformity was preferable, he suggested, than a situation in which registration were to be handled by a national bureau which could perpetuate mistakes in all the states.

"Uniformity will be achieved in the spirit of our procedures long before it will be achieved by identical laws."

"The future of the registration movement is bright," he said. "It has been solidly established on a sound legal basis and there have been enough court decisions to show the most confirmed skeptic that registration has a real place in building an engineering profession."

Declaring that the NCSBEE can use some new blood, Mr. Dougherty urged that younger members be invited to council meetings. New members, he suggested, may well bring new ideas which have not been considered during the formative years of the Council but which would undoubtedly be needed for future development.

New Officers

The following officers were appointed for 1951: *President*, Russell G. Warner, New Haven, Conn.; *vice-president*, C. S. Crouse, Lexington, Ky.; *board of directors*, Clarence Eckel, Boulder, Colo.; Stanley G. Palmer, Reno, Nev.; A. G. Stamford, Atlanta, Ga.; Thomas C. Shedd, Urbana, Ill.; Ned Spaulding, Hudson, N. H.

Boston, Mass., was selected as the annual-meeting city for 1951, and Denver, Colo., for 1952.

157,000 Registered Engineers

In his annual report as executive secretary T. Keith Legaré reported that there were at least 157,000 registered professional engineers in good standing in the United States and territories; also that 18,647 engineers in training were registered in 26 states. Member boards reported that they had registered 25,626 engineers from other states, a fact that "emphasizes the importance of interstate registration and the need for workable procedures for handling this important feature of registration."

During the year Louisiana, New Hampshire, New Jersey, and Oregon amended their registration laws.

Registration by Endorsements

Based on its 10 years of study of the problem of facilitating free flow of engineering talent and services across state lines, the Committee on Registration by Endorsement, headed by D. B. Steinman, suggested six policies for consideration of various boards. They are:

1 Written examinations should be waived for applicants who have successfully passed reasonably equivalent written examinations for registration in another state.

2 Written examinations should be waived in the case of applicants of long-established and recognized professional standing.

3 The requirement of oral examination or personal interview should be waived wherever possible in the case of out-of-state applicants of established qualifications who are registered in other states.

4 An engineer registered in other states should not be penalized for not securing registration in a given state before he actually needs such registration.

5 The registration and renewal fees for certification or registration by endorsement should be kept to a minimum.

6 The repeated checking of educational credentials, character references, and experience endorsements should be minimized.

Since American engineers "cannot have the ideal of a single national registration," the report concludes, state boards should strive to minimize the obstacles created by state lines. Professional engineers constitute a single profession and state lines should not be permitted to break up solidarity. Engineering registration should be kept sensible, clean, and fair.

The Committee on Engineers in Training took cognizance of the aptitude among recent college graduates for crossing state borders during the first four or five years following graduation, and questioned the advisability of charging annual renewal fees for engineers-in-training certificates.

What Nonengineers Think About Engineering Registration

THE opinion of nonengineers, especially personnel executives and officials who employ engineers, was the objective of a recent survey concluded by the National Council of State Boards of Engineering Examiners, the results of which were reported during the recent NCSBEE annual meeting in Chicago, Ill. A questionnaire was sent to 277 organizations in various parts of the country employing large engineering staffs, asking three questions about the effects of registration on company operation.

Summary of Replies

The following is a summary of the 174 replies received:

1 Do you feel that the registration of engineers is advantageous? (*a*) To the public? Yes, 137; No, 12; In doubt, 6. (*b*) To your company? Yes, 83; No, 59; In doubt, 5. (*c*) To the engineering profession? Yes, 131; No, 13; In doubt, 7.

2 In your organization is the registration of engineers recognized? (*a*) By requiring registration of engineers for certain positions of responsibility? Yes, 46; No, 101. (*b*) By favoring the employment of engineers who are registered? Yes, 29; No, 111. (*c*) By encouraging the registration of men in your employ who are qualified for registration: Yes, 96; No 52.

3 Do you feel that registration is (*a*) Raising the standards of engineering practice? Yes, 109; No, 25; In doubt, 9. (*b*) Getting public recognition? Yes, 81; No, 44; In doubt, 15.

Comments

Organizations were also asked to comment on engineering-registration laws. The following are some of the comments selected at random from the replies of more than 60 returned with the questionnaires:

License requirements should be more stringent and some method of policing or censoring individual activities should be initiated.

While we do not require registration, we find that registered engineers are proud of their achievements.

Frankly, we have no interest in registration for engineers employed by our company.

We depend on the management of our company to maintain engineering standards and have not concerned ourselves much over registration.

Professional engineers do little drum beating, hence do not get the recognition they deserve. However, sales and application men, often not capable of actual engineering, particularly seek registration and then do the drum beating for the profession. Registration laws should be made restrictive and the level raised somewhat.

We are favorably inclined but will be influenced by future attitude of ASME.

A company when hiring usually digs deeper into a man's qualifications than mere evidence of registration.

We require engineers in supervising positions, and particularly where public contact is an important part of the job, to be registered.

Outside of protecting the public, registration does nothing a good technical society should not already be doing.

Quite worth while, but needs more policing.

Law should be strengthened and be better administered.

Registration is a step in the right direction.

Registration seems to increase the stature of the profession in the eyes of the public.

We see little value in registration, but feel sure the value will grow if the law is fairly and professionally administered. We hope for more uniformity between states.

Registration is sure to raise standards in engineering practice.

AWS Holds 31st Annual Meeting Oct. 22–27

THE American Welding Society held its 31st annual meeting at Hotel Sherman, Chicago, Ill., Oct. 22–27, 1950. Members who attended the sessions had an opportunity to supplement their knowledge of the most recent developments in welding, cutting, and the allied processes, and those who visited the 32nd National Metal Exposition and Congress, held at the International Amphitheatre, saw the results of welding research and its practical application in industry.

Announcement of the new officers and presentation of medals and awards highlighted the meeting. Harry W. Pierce, assistant to the president, New York Shipbuilding Corporation, Camden, N. J., was elected AWS president for the coming year. Charles H. Jennings, engineering manager, welding department, Westinghouse Electric Corporation, was elected first vice-president for 1950–1951. Mr. Jennings has been selected as the 1950 Adams Lecturer, an honor awarded annually to an outstanding welding scientist or engineer. Also elected at this meeting was Fred L. Plummer, Mem. ASME, director of engineering, Hammond Iron Works, Warren, Pa., to serve as second vice-president.

Wendell F. Hess, head of the department of metallurgical engineering, Rensselaer Polytechnic Institute, was awarded the Samuel Wylie Miller Memorial Medal for his outstanding contributions to the advancement of welding and cutting of metals. Howard S. Avery, research metallurgist, American Brake Shoe Company, was selected as the winner of the 1950 Lincoln Gold Medal. This medal is awarded annually to the author of the paper judged the greatest original contribution to the advancement and use of welding. Mr. Avery's winning paper, "Hot Hardness of Hard Facing Alloys," was published in the July, 1950, issue of *The Welding Journal*.

Also announced were the winners of $2000 in prizes in the 1950 Resistance Welder Manufacturers Association prize contest. J. W. Kehoe, Westinghouse Electric Corporation, was the winner of the $750 first prize for the best paper from an industrial source as the author of "A Practical Method for Obtaining Consistent Resistance Welds." The second prize of $500 went to three Franklin Institute engineers: A. O. Bergholm, P. W. Swartz, and G. S. Hoell, Mem. ASME, for their paper entitled "Stress Distribution Around Spot Welds." I. S. Goodman, Westinghouse Electric Corporation, received the $250 third prize for his paper on "Variables in Cross-Wire Welding of Dissimilar Metals."

For the best paper from a university source Dr. Georges Welter, École Polytechnique, University of Montreal, Can., was selected the winner of the $300 first prize for his paper on "Fatigue Tests of Spot-Welded Steel Sheets." The second prize of $250 was awarded to W. B. Kouwenhoven, The Johns Hopkins Institute, and W. T. Sackett, Jr., Battelle Memorial Institute, for their paper entitled "Electrical Resistance Offered to Non-Uniform Current Flow."

SAM Explores Man-Power Situation at 1950 Fall Meeting

NATIONAL man-power mobilization was foremost among the problems explored by industrialists, business analysts, and government officials at the 1950 fall meeting of the Society for the Advancement of Management held at the Hotel Statler, New York, N. Y., Nov. 2–3, 1950.

Even in the first stages of our limited defense program an occupational man-power shortage is already developing, Robert C. Goodwin, executive director, Office of Defense Man Power, told the meeting. In September and October a marked increase was noted in the shortage of engineers and metalworking craftsmen, he said.

Goverment Man-Power Policies

To aid industry in its man-power problems, the Government has instituted the following policies: (1) Employers are being asked to place orders for additional workers with local offices of state-employment services; plant-wide inventories of workers were recommended; (2) public employment offices are revising activities to meet these new demands resulting from man-power studies; (3) studies, analyses, and reports are being prepared on defense-connected problems by Government agencies; (4) local public employment offices are recruiting needed workers and encouraging better use of skills; (5) technical assistance is being supplied to employers on staffing for conversion to defense output; (6) needless migration between communities and pirating and hoarding of employees are being discouraged; (7) where intense competition for employees exists, top priority is being given to defense establishments; (8) the Department of Labor and the National Security Resources Board, the Department of Defense, and the Selected Service System are participating in policy decisions on draft inductions, recall of reservists and national guardsmen, and conservation of "key" or critical workers essential to defense work; (9) indiscriminate advertising for employees is being discouraged. In-plant training and up-grading and voluntary transfers are being encouraged.

PHIL CARROLL, MEM. ASME, RECIPIENT OF 1950 GILBRETH MEDAL

Describing the present situation as "half war," Leo Cherne, executive secretary, Research Institute of America, New York, N. Y., told a luncheon audience that the nation was facing rearmament with almost no unused reserves of man power. In meeting the needs of the Armed Forces, he continued, it would be the younger, more resilient, frequently better-trained personnel, who would be particularly hurt. "Most of our foremen who will bear the brunt of tomorrow's output are in the under-40 group. The scientific, professional, and technical personnel so important to the services are in the age group prized by the Army," he said. Referring to increasing material shortages, Mr. Cherne predicted that where truly short supplies develop, priorities and allocations would break down and would have to be replaced by a more precise method of distribution.

Somervell and Carroll Honored

Gen. Brehon Somervell, U. S. Army, Ret.,

president, Koppers Company, Inc., Pittsburgh, Pa., was awarded the Taylor Key, annual award of the SAM, presented for major contributions to the science of management. In his acceptance address, General Somervell stated that if the internal and external affairs of the nation were subjected to the same discipline which is generally found in private enterprise, the country would not face today some of its disturbing problems.

Phil Carroll, Mem. ASME, industrial engineer, Maplewood, N. J., was awarded the Gilbreth Medal for 1950, for his contributions to work measurement in the field of industrial engineering. Through his textbooks, Mr. Carroll is well known in American industry for his writings on management controls, work standards and cost practices, and elimination of fatigue in industrial work.

Economics of Machine Replacements

A sound policy of replacement of worn-out and obsolete equipment was urged by Everett M. Hicks, manager, Grinding Machine Division, Norton Company, Worcester, Mass., in a paper on "Economics of Machine Replacements." According to Mr. Hicks, 43 per cent of the machines in use today are over 10 years old. One out of every five machine tools is more than 20 years old. He estimated that current postwar models were one third more productive than similar machines of prewar design. He attributed to the use of haphazard and rule-of-thumb methods for testing proposed replacements the failure to modernize continually on the part of management. A second factor, Mr. Hicks said, was a false conservatism on the part of financial executives who feel that security in business lies in sound bank balances rather than in modern machinery.

ASHVE Research

THE American Society of Heating and Ventilating Engineers is supporting research in fundamental problems of heating, ventilating, and air conditioning in seven colleges and universities. In each case a grant of funds is made by ASHVE to the institution which in turn utilizes its own laboratory facilities and faculty in projects under the direction of the society's research advisory committee. ASHVE also supports its own laboratory in Cleveland, Ohio. In addition to contributions from individuals, government agencies, and industrial sources, the Society allocates 40 per cent of its annual membership dues for research purposes.

Schools co-operating in the program are: College of Medicine, University of Illinois, Chicago, Ill.; Case Institute of Technology, Cleveland, Ohio; Kansas State College, Manhattan, Kan.; Michigan State College, East Lansing, Mich.; Cornell University, Ithaca, N. Y.; University of Minnesota, Minneapolis, Minn.; University of Florida, Gainesville, Fla.

The research projects include such problems as air friction in the various fittings attached to the rectangular ducts, the effectiveness of high-velocity air streams for ventilating dust-ridden work areas, and physiological adjustments of human beings to sudden changes in environment.

Nation Facing Sacrifices Major Eliot Warns

THE military policy of the United States is one of "perpetual readiness" to ward off attack anywhere against the free world, according to Major George Fielding Eliot, military analyst for the Columbia Broadcasting System. Major Eliot spoke before the Metropolitan Section of The American Society of Mechanical Engineers at the Tavern-on-the-Green, New York, N. Y., Oct. 23, 1950.

Because the policy entails prohibitive costs, the United States must undertake "calculated risks." This meant, he said, that for the first time the American people were faced with the possibility of actual war at home. To make the nation strong, this generation of Americans would be called upon to make many changes in their traditional way of life. "Business and pleasure as usual" will not be enjoyed for many years, Major Eliot stated.

Other changes, Major Eliot said, the country could expect were: One or two years of universal military service for all citizens beginning in their 19th or 20th year; more controls in business; registration of women; and more or less of a continuing defense economy.

The nation's military obligations call for U. S. marine divisions with ample amphibious "lift" and their own tactical air arm acting in support of naval carrier task groups to achieve quick emergency action in any part of the world.

Should Soviet aggression materialize again, he warned, this country ought to be in a position to meet it with a reserve of fully ready ground troops and tactical aircraft in the United States, together with sufficient European forces and U. S. troops already in Europe able to contain the Soviet thrust until additional forces can be mobilized. These forces, he added, should be able to support also naval and marine forces in emergency operations elsewhere than in Europe.

Many Engineering Societies to Take Part In ASCE Centennial

ELEVEN national technical societies, including The American Society of Mechanical Engineers and one Canadian society have already taken formal action to participate in the international engineering convocation to be held in Chicago, Ill., Sept. 3-13, 1952, to celebrate the one hundredth anniversary of the founding of the American Society of Civil Engineers, the oldest professional engineering society in America.

American and overseas engineering organizations have been invited to hold major meetings in Chicago, Ill., during the convocation period so that engineers from all over the world can "gather to exchange ideas and information of value to one another with no one group taking place of special prominence." The convocation is under management of Centennial of Engineering, 1952, Inc.

When the ASCE was founded in 1852, the designation, civil engineer, was quite different from that accepted today, being used to differentiate them from the specialized work of the military engineer. It included all branches of the engineering profession as well as architects. As the industrial revolution expanded to the giant concerns of today, and as with the other professions, specialization became necessary. Various groups of engineers such as mining, mechanical, electrical, and chemical, formed societies of their own, but all had their inception in the original society of civilian engineers founded in 1852.

During the one hundred years that have passed since the founding of the American Society of Civil Engineers, the branches of the engineering profession have grown more specialized and less generally informed about the activity of the profession at large. The Centennial Convocation will give the engineers of the country an opportunity to attend meetings and hear technical papers of the other branches of engineering, and to obtain pertinent information on the developments available to them from specialties outside their own fields.

An important part of the Centennial of Engineering celebration will be an Exposition during the months of July, August, and September, 1952. The incorporators of the Centennial of Engineering have stated, "The purpose of the Centennial Exposition should be to tell the story of engineering and industry to the general public." The story of engineering and industry is one story. To take either without the other would be almost impossible. For this reason it is essential to the engineer that our industrial system be preserved on the same freely competitive basis on which it has been built.

Hoover Manifesto Urged Engineers to Vote

THE Civic Responsibility Committee of The American Society of Mechanical Engineers issued a nonpartisan manifesto prior to the November elections urging engineers and all Americans to exercise their right to vote. The manifesto which declared "American blood is being shed overseas. Do not let democracy at home go by default," was prepared by Herbert Hoover, former president of the United States, and an Honorary Member of the ASME. It was signed by 28 other Honorary Members of the Society.

"This is a time of many crises," the manifesto read. "Some of them reach deeper than even war." It declared that "this country stands as a great bulwark of freedom against the forces of totalitarianism" and warned that "Americans are in serious danger of losing their priceless heritage of liberty within these shores through the shocking indifference of a substantial portion of our electorate."

The statement was given wide publicity in the daily press and on some of the New York radio stations. According to William A. Hanley, vice-president, Eli Lilly and Company, Indianapolis, Ind., chairman, ASME Civic Responsibility Committee, local ASME meetings under the auspices of his committee were held throughout the nation in a drive to get out the vote.

Progress Reported in High-Temperature Alloy-Steel Research Project

MORE than $100,000 in money, materials, and services have been contributed to The American Society of Mechanical Engineers for a study of what happens to a large number of high-temperature alloy steels and welded composite specimens when subjected to action of steam and corrosive gases at high temperatures for extended periods.

The contributions will support a long-term research project sponsored by the ASME Research Committee on High-Temperature Steam Generation in co-operation with industrial and research organizations interested in high-temperature industrial processes.

What initiated the project was the realization by engineers that further economies in steam-power generation lay in the direction of higher temperatures; that limited knowledge was available about how some of the common and recently developed high-temperature alloy steels withstand temperatures above 1050 F; and finally, that if such knowledge were available, it would be applicable to other high-temperature industrial processes.

Objectives of Program

For the alloys in question, this long-range investigation will study the following factors at temperature levels up to 1500 F: (1) Nature, thickness, permanence, and thermal conductivity of oxide films formed on steam-swept surfaces; (2) Resistance to gases encountered in commercial services; (3) Metallurgical stability; (4) Effects of repetitive moderate temperature shock; (5) Behavior of welded composite specimens.

Some of the metals to be investigated are: *At 1100 F and 1200 F*—G.E. chrome-moly-vanadium, SA-213-T22, SA-213-T21, SA-213-T5, SA-213-T16, SA-213-T13, SA-213-T9; Welded composite specimens; *At 1200 F, 1350 F, and 1500 F*—AISI-Type 304, AISI-Type 347, AISI-Type 321, AISI-Type 316, AISI-Type 310, AISI-Type 309S, Rustless GT-45, Timken 16-25-6, Inconel, Hastelloy C, and welded composite specimens.

Co-Operating Agencies

In a recent progress report, the ASME Committee summarized advances made by the following research agencies:

Purdue University: Under the direction of Prof. H. L. Solberg, head, School of Mechanical Engineering, equipment is being constructed for measuring the temperature drop across scale formed in the tubular specimens. About 300 specimens will be studied after having been exposed to high-temperature high-pressure steam for periods of from three months to three years. Data on the corroded tubes will be compared with data for new tubes of the corresponding materials to determine influence of the corrosion products upon heat transfer.

Battelle Memorial Institute: Under the immediate supervision of J. H. Jackson, the resistance of a number of unstressed austenitic alloys to gases encountered in commercial service is being studied in co-operation with 13 plants in various parts of the country. Specimens will be exposed for about one year in boiler furnaces, fired by various methods, in a region where the gas temperature 1350 F. Some of the co-operating plants burn oils from several sources while others utilize pulverized-coal firing with various burning systems. The preliminary design of the test rack was recently completed.

This field program was designed to complement closely controlled laboratory tests at Battelle, in which specimens of the same alloys will be exposed to different atmospheres at 1350 F for 1000 hours. All possible combinations of atmospheres having a high and low sulphur content, a high and low alkali content, and a high and low carbon-dioxide content will be used.

ASME Research Committee on High-Temperature Steam Generation: To provide specimens for the heat-transmission studies at Purdue, and for metallurgical examination elsewhere, several ferritic and austenitic materials in tubular form will be subjected to high-temperature high-pressure steam for periods up to three years. The general design of the test racks in which the specimens will be exposed to steam at temperature levels up to 1500 F has been completed. This is also true of superheaters, heat exchangers, and a desuperheater. The racks will ultimately be installed at the Twin Branch Plant of the Indiana and Michigan Electric Company, American Gas and Electric Company System, at Mishawaka, Ind. Twin Branch will supply steam initially at 2050 psig and 1050 F to the Committee's equipment.

Bureau of Ships, Department of the Navy: Detail design and construction of the five test racks, superheaters, heat exchangers, and desuperheater, for the Twin Branch Plant is being undertaken by the U. S. Naval Engineering Experiment Station, one of the Bureau's laboratories. Welding investigations of some of the lesser known materials are being made prior to rack fabrication. Another unit operating under the Bureau, the Naval Boiler and Turbine Laboratory, is concerned with developing instrumentation necessary to the operation of the racks.

Committee

Members of the ASME Research Committee on High Temperature Steam Generation are:

H. L. Solberg, *chairman*, head, School of Mechanical Engineering, Purdue University, West Lafayette, Ind.; W. H. Armacost, vice-president, Combustion Engineering-Superheater, Inc., New York, N. Y.; C. L. Clark, metallurgical engineer, Special Steel Developments, Steel and Tube Division, The Timken Roller Bearing Company, Canton, Ohio; C. H. Fellows, head of chemical division, research department, The Detroit Edison Company, Detroit, Mich.; S. N. Fiala, mechanical engineer, head, mechanical-engineering division, American Gas and Electric Service Corporation, New York, N. Y.; R. C. Fitzgerald, senior engineer, Westport Power Production Station, Consolidated Gas Electric Light and Power Company of Baltimore, Baltimore, Md.; C. C. Franck, manager, land-turbine engineering, steam division, Westinghouse Electric Corporation, Philadelphia, Pa.; E. P. Hansen, design engineer, steam-turbine department, Allis-Chalmers Manufacturing Company, Milwaukee, Wis.; H. H. Hemenway, executive assistant, Foster-Wheeler Corporation, New York, N. Y.; V. N. Krivobok, in charge of stainless-steel section, Development and Research Division, The International Nickel Company, Inc., New York, N. Y.; J. P. Magos, director of research, Engineering and Research Division, Crane Company, Chicago, Ill.; W. H. McAdams, professor, department of chemical engineering, Massachusetts Institute of Technology, Cambridge, Mass.; George Parmakian, mechanical engineer, Riley Stoker Corporation, Worcester, Mass.; E. L. Robinson, structural engineer, turbine-engineering division, General Electric Company, Schenectady, N. Y.; W. H. Rowand, chief engineer, The Babcock & Wilcox Company, New York, N. Y.; and L. B. Schueler, sales manager, Diamond Power Specialty Corporation, Lancaster, Ohio.

Meetings of Other Societies

Dec. 16

Institue of the Aeronautical Sciences, 14th Wright Brothers Lecture, U. S. Chamber of Commerce Auditorium, Washington, D. C.

Dec. 18–20

American Society of Agricultural Engineers, winter meeting, Hotel Stevens, Chicago, Ill.

Dec. 21

National Industrial Conference Board, Inc., Hotel Waldorf-Astoria, New York, N. Y.

Dec. 26–30

American Association for the Advancement of Science, Hotel Statler, Cleveland, Ohio

Jan. 8–12, 1951

Society of Automotive Engineers, annual meeting and engineering display, Hotel Book-Cadillac, Detroit, Mich.

Jan. 16

American Boiler Manufacturers Association and Affiliated Industries, midwinter meeting, Hotel Cleveland, Cleveland, Ohio

(For ASME Calendar of Coming Events see page 1031)

Coming Meeting Notes

Plastics

"PLASTICS Shape the Future" will be the theme of the Seventh Annual National Technical Conference of the Society of Plastics Engineers, Inc., to be held at the Hotel Statler, New York, N. Y., Jan. 18–20, 1951. The technical program has been arranged as a review of technological achievements in the field of plastics during the last 50 years. All persons in the plastics and related industries are invited. SPE, whose membership numbers over 2200 and is divided into 27 local sections in all parts of the United States, Canada, and Mexico, encourages original work in plastics engineering, promotes the development of engineering standards, and publishes work of value to plastics technologists. C. Todd Clark, F. Burkart Manufacturing Company, St. Louis, Mo., is president.

Plant Maintenance

THE Plant Maintenance Show will be held in the Public Auditorium, Cleveland, Ohio, Jan. 15–18, 1951. A plant-maintenance conference will be held concurrently consisting of four general sessions and eight sectional conferences.

Preventive maintenance will be the first topic at the general sessions. The sessions will divide into four sectional conferences on specific maintenance problems. The topics to be covered will be maintenance of electrical equipment, power-plant and heating equipment, maintenance problems of the small plant, and selection and maintenance of lighting equipment.

The American Society of Lubrication Engineers will conduct a panel on lubrication on the third day of the conference.

Air Conditioning

THE Tenth International Heating and Ventilating Exposition will be held at the Commercial Museum, Philadelphia, Pa., Jan. 22–26, 1951, in conjunction with the 57th Annual Meeting of the American Society of Heating and Ventilating Engineers. Five technical sessions are planned on smoke measurement, solar radiation, air flow and its measurement, and heat-pump performance.

Metals

THE Seventh Western Metal Exposition will be held March 19–23, 1951, at the Auditorium and Exposition Hall, Oakland, Calif. More than 200 metal firms will exhibit new products and demonstrate application of metals in the oil, chemical, manufacturing, aviation, construction, mining, and other industries. Under the theme, "Production for America," 100 technical papers are planned, covering developments in processing, working, fabricating, treating, and application of metals. The Exposition will be sponsored by the American Society for Metals, in co-operation with 20 other national technical societies.

Materials Handling

THE Fourth Materials Handling Exposition will be held at the International Amphitheatre, Chicago, Ill., April 30–May 4, 1951. A technical program taking up various aspects of materials handling will be held during three days of the exposition. The program will be sponsored by the American Materials Handling Society.

Forest Products

THE Convention Hall in Philadelphia will look like a large woodworking factory in full production when the Forest Products Research Society holds its annual meeting in Philadelphia, May 7–13, 1951, marking the Fifth Anniversary of its founding at the Forest Products Laboratory, Madison, Wis. A nonprofit organization, F.P.R.S. works to facilitate exchange of information among individuals interested in forest products by publishing and distributing pertinent information in the field. Its main objective is to encourage and promote efficient utilization of forest products.

Structural Engineering

THE Fourth Congress of the International Association for Bridge and Structural Engineering will be held during a week in August, 1952, Cambridge, Great Britain. The technical session will be divided under three classifications: (1) General questions; (2) Metal structures; and (3) Concrete and reinforced-concrete structures. Under General Questions, loading of bridges and structures, and dynamic problems will be taken up. Under Metal Structures, the Congress will consider welding and welded connections, structural steel, and light metals, and details of design. Under the third classification, such topics as composition of concrete, effect of repeated and continuous loading, and dynamic stressing and fatigue strengths, will be taken up.

Engineering Literature

Gears

A NEW American Standard on Gear Nomenclature, ASA B6.10-1950, recently published by The American Society of Mechanical Engineers, assembles in one document terms, definitions, and illustrations pertaining to gear nomenclature. Except for changes in arrangements, the new standard is essentially Standard No. 112.02 developed by the American Gear Manufacturers Association. Price of the 21-page standard is $1.50. Order from ASME Order Department.

Involute Splines

THE American Standard Involute Splines (ASA B5.15-1950) was recently published by The American Society of Mechanical Engineers. The standard is a revision of the 1946 edition and contains changes and additions recommended by the National Aircraft Standards Committee to define fits required for interchangeable assembly.

Involute splines are multiple keys in the general form of internal and external involute gear teeth, and are used to prevent relative rotation of cylindrically fitted machine parts. The standard covers involute splines $^{1}/_{2}$ (one/two) diametral pitch to 48/96 diametral pitch, and from 6 teeth to 50 teeth, for both flat root and fillet root types.

The 69-page standard contains 33 tables and is profusely illustrated. Price per copy is $2. Order from ASME Order Department, 29 West 39th St., New York 18, N. Y.

ASME Boiler Code

THE following addenda to the ASME Boiler Construction Code approved by Council of The American Society of Mechanical Engineers up to August 3, 1950, are now available on perforated sheets suitable for cutting up and pasting into published codes: Unfired Pressure Vessel Code, seven sheets, 35 cents; Welding Qualifications Code, 1 sheet, 10 cents; Low-Pressure Heating Boiler Code, 9 sheets, 40 cents; Power Boiler Code, 6 sheets, 35 cents. Copies can be obtained from ASME Order Department.

Nuclear Energy

SECTION III, Reactor Engineering, of a proposed American Standard Glossary of Terms in Nuclear Science and Technology was recently issued in a preliminary edition by The American Society of Mechanical Engineers.

This is the third in a series of nine pamphlets which will cover nuclear terms and technology in major fields of science and technology. The Glossary is sponsored by a Conference of 21 scientific societies and agencies organized by the National Research Council in 1948. Section III consists of 20 pages of definitions and 20 pages of an alphabetical index of terms appearing in all nine of the sections.

Sections of the glossary still in preparation are: I General Terms, II Reactor Theory, IV Chemistry, VII Instrumentation, VIII Isotopes Separation, IX Metallurgy. Earlier this year preliminary editions of the following two sections were issued: V Chemical Engineering; and VI Biophysics and Radiobiology.

Preliminary editions are being issued to make information in the glossary available promptly and to afford users the opportunity to criticize and suggest revisions before the Glossary is finally accepted as an American Standard. Price is 75 cents. Order from ASME Order Department.

New AIEE-ASME Preferred Standard for Steam Turbine-Generators

THE Joint AIEE-ASME Committee on Steam Turbine-Generators has completed a review of the prevailing standards. This revision has been approved by the American Institute of Electrical Engineers and The American Society of Mechanical Engineers.

The revision consists primarily of the addition of a 90,000-kw turbine-generator to the group of preferred-standard machines. This means that the standards now cover seven machines: An 11,500-kw air-cooled machine, and 15,000-kw, 20,000-kw, 30,000-kw, 40,000-kw, 60,000-kw, and 90,000-kw hydrogen-cooled units. The new 90,000-kw turbine will be available either as a regenerative-cycle machine or a reheat-cycle machine.

The new generator is rated at 0.5 psig hydrogen pressure with 15 per cent additional kva capability above generator rating provided by increasing the hydrogen pressure to 15 psig similar to the other hydrogen-cooled machines. In addition, it will be designed for operation at 30 psig under which condition the generator capability will be 25 per cent above its rating at 0.5 psig. The excitation voltage will be 375 volts with an option of 250 volts.

The generator voltage will be 13.8 or 14.4 kv. The characteristics of the remaining machines have not been changed from the previous edition of the standard except for the elimination of 11.5 kv as a standard generator voltage. This change was found desirable because of the very few machines that were purchased with this voltage.

The revised ASME Standard No. 100 is now available, and includes: (*a*) Preferred Standards for Large 3600-Rpm 3-Phase 60-Cycle Condensing Steam Turbine-Generators (Larger than 10,000-Kw Rated Capacity), and (*b*) Standard Specification Data for Generators for large 3600-Rpm 3-Phase 60-Cycle Condensing Steam Turbine-Generators (larger than 10,000-kw Rated Capacity).

Price per copy is 60 cents. Order from ASME Order Department, 29 West 39th Street, New York 18, N. Y.

People

ASME Elects Nine Fellows

THE American Society of Mechanical Engineers has honored nine of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer who has acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and has been a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men who, by virtue of their contribution to their profession and to the Society, were so honored are:

John F. Barkley

John F. Barkley, chief, Fuels Utilization Division, Bureau of Mines, Washington, D. C., has contributed conspicuously to the early research work conducted by the Bureau of Mines with Henry Kreisinger, which resulted in new basic information on heat transfer through boiler tubes and the radiation error in measuring the temperature of gases. Later methods for improving fuel-burning equipment and the new information developed in federal plant betterment were passed on to industry. Considerable information on smoke and fly ash and their prevention was developed in the federal government and assistance was given many cities on smoke abatement. The ASME publication "Example Sections for a Smoke Regulation Ordinance" was prepared after seven years of work by the Fuels Division Model Smoke Law Committee, of which Mr. Barkley was chairman. During the war the national fuel-efficiency program, under Mr. Barkley's general supervision, contributed substantially to the country's war effort in saving fuel. He is author or coauthor of numerous technical papers and Bureau of Mines bulletins which are widely used throughout the industry and profession. He is the inventor of the intake feeder for suction conveyer.

Llewellyn M. K. Boelter

Llewellyn M. K. Boelter, chairman of the department and dean, College of Engineering, University of California, Los Angeles, has made notable contributions to research and teaching. He has been partially instrumental in the development of the following devices and instruments: Heat meter, radiometer (plated pile), head lamp testing stand, radiation integrator, and thermal analyzer. He is author of some 70 technical papers on heat transfer, mass transfer, and engineering education. He was chairman of the ASME Heat Transfer Division, 1943–1944, and is an active participant in many technical and educational societies. At UCLA he has solidified and extended techniques for handling of students in engineering, instruction in the engineering curriculum, and engineering-extension and engineering-research divisions. He is responsible for the off-campus graduate program at Naval Ordnance Test Station, Inyokern, Calif., and Naval Electronic Laboratories, San Diego, Calif.

Oliver F. Campbell

Oliver F. Campbell, consultant and chief combustion engineer over all Sinclair Refining Company plants, has been one of the early adherents of Kreisinger, and through his efforts the use of pulverized coal was initiated on an oil-refinery tube still. He took part in a new program of fuel conservation in the oil industry and has devoted his entire life to this activity. Due primarily to his efforts, working with furnace designers, cylindrical furnaces were designed which called for an entirely different concept of burner arrangement. Commercial applications now incorporate his ideas on furnace design and a number of industries have converted from other fuels to oil firing due to his ability to analyze situations and redesign equipment. His research has given impetus to higher pressures and superheat temperatures in steam generation; impetus to proper design of furnaces, heat release, heat absorption, and design of burners. In the field of water treating and water inhibiting his knowledge of operation and design has greatly influenced the high degree of success in water used for both steam generation and process equipment. He has served on many ASME committees and is a past-chairman of both the Fuels Division and the Power Division. He served on the Model Smoke Law Committee of the Fuels Division and on the Special Research Committee on Furnace Performance Factors sponsored by ASME. He is the ASME representative on the American Gas Association Subcommittee on Requirements for Installation of Gas-Burning Equipment in Power Boilers. During World War II he served on the National Fuel Efficiency Council. He has been active in the local Chicago Section of ASME and the Annual Chicago Power Conference. He is the author of many technical papers and holds several patents.

John A. Goff

John A. Goff, dean, Towne Scientific School, director of the department of mechanical engineering, University of Pennsylvania, and Whitney professor of dynamical engineering, has served the ASME as chairman of the Applied Mechanics Division, 1935; Professional Divisions Committee, 1946; and Special Research Committee on Properties of Gases and Gas Mixtures until Dec. 31, 1949. His work on the determination of the thermodynamic properties of moist air has been adopted as an international standard by the International Meteorological Organization in 1947 and will appear in the forthcoming revision of Smithsonian Meteorological Tables. He is the author of some thirty technical papers and the book "Notes on Thermodynamics," an undergraduate text on engineering thermodynamics which is a unique treatment of the subject.

Thomas A. Marsh

Thomas A. Marsh, Iron Fireman Corporation, Cleveland, Ohio, has done much work in the field of design of stokers, chain-grates, underfeeders and spreaders, and contributed measurably to early improvements of furnace design. He holds several patents on fuel-burning equipment and accessories. His work has resulted in improvement in efficiency of burning Midwestern and lower-rank coals including subbituminous coal and lignite. He made draft-loss studies and established standards where none previously existed and corrected draft-system difficulties which led to his designs of many unusual draft systems. He served for ten years on the Advisory Committee of the Chicago, Ill. Department of Smoke Abatement and is now serving on a similar committee in the City of Cleveland. He has for many years been quite active in and is a past-chairman of the ASME Fuels Division, and has been a member of the ASME Model Smoke Law Committee since its inception. He has presented four technical papers at ASME meetings and has had 42 papers published. He is the author of "Combustion in the Power Plant" and "How to Buy, Sell, and Burn Coal." He has given over 300 lectures before engineering groups on fuel burning and fuel conservation. He was recipient of the Percy Nicholls Award in 1945 for notable scientific and industrial achievement in the field of solid fuels.

William Mittendorf

William Mittendorf, combustion engineer, who from all indications was the first man in Cincinnati to have the title, has been with the Holmes-Darst Coal Corporation, Cincinnati, Ohio, since 1922. He has made important

contributions to the technique of preparing and sizing coal. He was the first to successfully weigh bagasse on scales for making an eight-hour evaporative boiler test on a 500-hp boiler using natural draft. He designed the furnace on which this test was made. Since Mr. Mittendorf joined Holmes-Darst, he has taken a keen interest in quality control of the company's product and was instrumental in organizing and establishing a laboratory for analyzing coal samples from the Holmes-Darst mines to regulate quality. He has been actively engaged in consulting-engineering work over a wide area and as a teacher he has counseled and tutored many young men in the combustion-engineering field through the co-operative course at the University of Cincinnati. He has been connected with smoke abatement in Cincinnati and helped develop and guide the existing smoke ordnance into law.

John C. Siegesmund

John C. Siegesmund, director, Engineering Division, Eli Lilly and Company, Indianapolis, Ind., has greatly aided the progress made in the development of pharmaceutical processing equipment. This work resulted in the installation of fractional distillation, vacuum drying, and special hydrogenation equipment at the Lilly plant. He has worked on the development of processing equipment for the production of insulin. His scientific work includes aqueous distillation systems for under 50 F, heat balance in industrial plants, contributions in the field of low-temperature distillation processes, and the application of refrigeration to fractionating columns. He has instituted incentive systems for maintenance employees at the Lilly plant.

Hilding V. Tornebohm

H. V. Tornebohm, vice-president and technical director, Svenska Kullagerfabriken (SKF), Gothenburg, Sweden, is an engineer, teacher, and author. His influence at home and abroad, particularly at conferences on mechanical standards is well remembered by his colleagues. He has made contributions to the development of machine tools, especially in connection with ball and roller bearings, and to the promotion of gaging techniques and tolerances. For his work he has received the honorary degree DE from Stevens Institute of Technology, 1936; and Eidgenossische Technische Hochschule, Zürich, Switzerland, 1943. He delivered the third Calvin W. Rice Memorial Lecture at the ASME Semi-Annual Meeting, Dallas, Texas, 1936. He has been awarded several honors in recognition of his achievement by many countries. He is the author of books and papers published in Sweden and translated into many languages. He holds 20 patents concerning machine design and gaging tools.

George W. Watts

George W. Watts, director of engineering Standard Oil Company (Indiana), Chicago, Ill., whose career is marked by early and far-sighted interest in mechanical problems whose fundamental importance was generally recognized only at a later date, as early as 1918 appreciated the need for extensive experimental study of the change in tensile strength and other mechanical properties of metals at elevated temperatures. Information of this sort has since become invaluable to the design of equipment for petroleum refining and has made possible many other mechanical operations at elevated temperatures. Mr. Watts was searching for a sound theoretical basis for determining the behavior of vessels under internal pressure as early as 1925. He has been actively interested in this problem ever since. Part of his contribution to present knowledge on the subject is set forth in the paper on "Basic Elastic Theory of Vessel Heads Under Internal Pressure," published in the *Journal of Applied Mechanics*, March, 1949, pp. 55–73. In this paper Mr. Watts and his associate present a generalized computational approach to the analysis of stresses in pressure-vessel head. He was an early advocate of all-welded pressure-vessel construction and of nondestructive (x-ray and magnetic) inspection techniques. Mr. Watts has served on many technical committees. During the war Mr. Watts was granted leave of absence to direct for Kellex Corporation the design, construction, procurement, and erection of pumping equipment and process instrumentation for the Oak Ridge Uranium Diffusion Plant. At the present time Mr. Watts is a consultant for the Reactor Project of Brookhaven National Laboratory. He is also industrial representative on the National Research Council Committee on Undersea Warfare, Power, and Propulsion Panel. He has several inventions applying to oil-refining equipment.

* * *

JOHN T. RETTALIATA, vice-president, ASME, Region VI, was appointed vice-president of Illinois Institute of Technology. Dr. Rettaliata will become vice-president for academic affairs and will continue to hold his present office as dean of engineering.

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VLADIMIR K. ZWORYKIN, vice-president and technical consultant of the RCA Laboratories Division, Radio Corporation of America, whose basic research and developments have made television a present-day reality, was awarded the 1950 Progress Medal of the Society of Motion Picture and Television Engineers.

* * *

EARLE BUCKINGHAM, Mem. ASME, professor, mechanical engineering, Massachusetts Institute of Technology, was designated recipient of the Edward P. Connell Award for 1950 by the Awards Committee of the American Gear Manufacturers Association. Professor Buckingham was the ASME Worcester Reed Warner Medalist, 1944. He is the author of "Analytical Mechanics of Gears" (reviewed in MECHANICAL ENGINEERING, November, 1949, p. 951) and other books and papers.

* * *

IRVING LANGMUIR, ASME Holley Medallist, 1934, recently retired associate director, General Electric Research Laboratory, Schenectady, N. Y., was awarded the John J. Carty Gold Medal and Award by the National Academy of Sciences at the banquet held during the 1950 autumn meeting of the academy.

* * *

WILLIAM A. HANLEY, Fellow and past-president, ASME, was recently appointed president, board of trustees, Purdue University, Lafayette, Ind.

* * *

MARION W. BOYER, vice-president and contact director for manufacturing, supply, and transportation, and chemical products operations of Esso Standard Oil Company, has been appointed to the post of general manager of the U. S. Atomic Energy Commission as of Nov. 1, 1950.

* * *

KAUFMAN T. KELLER, Fellow ASME, president of the Chrysler Corporation, Detroit, Mich., was appointed by George C. Marshall, Secretary of Defense, to be director of guided missiles for the armed forces. In addition to advising General Marshall, Mr. Keller will act as a consultant on guided missiles for the Defense Department's Research and Development Board and the Munitions Board.

Call for Applications for Freeman Fellowship

THE American Society of Mechanical Engineers and the American Society of Civil Engineers have adopted a joint program for awarding the Freeman Fellowships. These societies will follow a common policy in making the awards; each will handle the applications and make the awards in alternate years, and both will give publicity to the award each year.

The Freeman Fund may be used for grants in aid of research, for aid in publishing meritorious works related to hydraulic engineering, for translations, and for prizes and fellowships. The committees in charge for the two Societies have agreed to use the funds for the present in support of advanced study or research. For the coming year, $2500 is available.

Applications for the Freeman Fellowship to be awarded by the American Society of Civil Engineers in 1951 are invited, subject to the following conditions:

1. The applicant must have completed three years of work or study in the field of hydrology or hydraulic engineering subsequent to receiving the bachelor's degree.
2. The applicant shall submit a program of study or research covering a period of at least nine months starting sometime during 1951.
3. The applicant shall submit a statement of the funds necessary under the fellowship in order to carry out the proposed program.
4. In making the award, preference will be given to the applicant who is a member of one of the two co-operating societies.
5. Applications should be submitted to the Society's Freeman Fund Committee in care of Secretary, American Society of Civil Engineers, 33 W. 39th Street, New York 18, N. Y., prior to Feb. 1, 1951. The committee plans to make the award by March 15, 1951.

ASME NEWS

ASME Members Approve Dues Increase

Increase Effective October, 1951

MEMBERS of The American Society of Mechanical Engineers increased their dues by approximately 25 per cent in a recent ballot on four amendments to the Society Constitution proposed at the 1950 Semi-Annual Meeting of the Society in St. Louis, Mo.

The dues amendment pertaining to Article C5 Section 2, was accepted by a margin of 118 votes, approved by two thirds of the votes cast being necessary for adoption.

Three other amendments concerning makeup of Council, the first meeting of Council, and the time of appointment of secretary and treasurer, were overwhelmingly approved by members. The dues increase will go into effect in October, 1951, therefore will not affect members who have not yet paid their dues for the current year.

The amended dues of the Society will be as follows:

Fellow	$25
Member	25
Associate	25
Junior Member for seven years after graduation or until he reaches the age of 30 whichever occurs later	10
Junior Member between seven and ten years after graduation, or between the ages of 30 and 33, whichever occurs later	20
Junior Member after ten years following graduation or after reaching the age of 33 whichever occurs later	25

Report of tellers for ballot amendments to the constitution which closed November 7, follows:

Total valid ballots	13528
Defective ballots	118
Total ballots cast	13646

	Votes For	Votes Against	No Vote
1 Increase in dues (Change in Article C5, Section 2)	9137	4351	40
2 Make-up of the Council (Change in Article C6, Section 2)	12376	1011	141
3 First meeting of the Council (Change in Article C6, Section 4)	13201	161	166
4 Time of Appointment of Secretary and Treasurer (Change in Article C8, Section 2)	13127	241	160

Signed HAROLD V. COES
H. B. OATLEY
WILLIAM H. BYRNE

AIME–ASME 13th Annual Joint Fuels Conference Held in Cleveland, Ohio

Julian E. Tobey 1950 Percy Nicholls Medalist

THE Thirteenth Annual Joint Conference of the American Institute of Mining and Metallurgical Engineers and The American Society of Mechanical Engineers was held at the Hotel Statler, Cleveland, Ohio, Oct. 24–25, 1950. Registration exceeded 300.

The two-day program included four technical sessions, two luncheons, and a banquet. The ladies' program consisted of an afternoon tea and a luncheon. All activities were well attended.

E. L. Lindseth Banquet Speaker

T. A. Marsh, Fellow ASME, Iron Fireman Manufacturing Company, Cleveland, Ohio, served as toastmaster at the banquet on Tuesday. The speaker was Elmer L. Lindseth, Mem. ASME, president, Cleveland Electric Illuminating Company, Cleveland, Ohio, who spoke on the subject, "The Kilowatthour in War and Peace." Mr. Lindseth said that if the present trend continues, electric-generating-plant capacity will triple in the next 20 years. He stated that the utilities have a dual responsibility, one to civilian service and the other to war preparedness. During the period ahead our liberties will be under strain; and a speculative boom, a stagnant standard of living, and tax rates so high as to stifle industry may bring about the loss of those things we are fighting for. He listed these essentials for businessmen: (1) Run your business successfully; (2) support the necessary control measures; and (3) develop executive man power with a broad outlook. These, he said, are methods to combat the ever-growing threat of socialism. He called for a better-informed people since indifference and ignorance are the greatest threat to our present system in America.

JULIAN E. TOBEY (*left*) ACCEPTS FRAMED CERTIFICATE OF THE PERCY NICHOLLS AWARD FROM E. G. BAILEY, PAST-PRESIDENT AND HON. MEM. ASME AT AIME-ASME JOINT FUELS CONFERENCE

Mr. Marsh introduced E. G. Bailey, past-president and Hon. Mem. ASME, who presented the Percy Nicholls award to Julian E. Tobey, Mem. ASME, president, Appalachian Coals, Inc., Cincinnati, Ohio. This award, established in 1942, is presented annually for notable scientific or industrial achievement in the field of solid fuels.

John Rowland Brown, president of the Reliance Gage Column Company, Cleveland, Ohio, was presented with the 50-year ASME Member Award by T. A. Marsh.

A. A. Potter, past-president ASME, dean of engineering, Purdue University, was called on to present the ASME certificate of Fellow grade to John Barkley, U. S. Bureau of Mines; T. A. Marsh, Iron Fireman Manufacturing Company; and William Mittendorf, Holmes-Darst Coal Company.

Two luncheons were held during the conference. Elmer R. Kaiser, chairman of the ASME Fuels Division, presided at the Tuesday luncheon. He introduced H. G. Dyktor, commissioner, Division of Air Pollution, City of Cleveland, who spoke on the subject "Meet the Smoke Inspector."

At Wednesday's luncheon, Carroll F. Hardy, chairman of the AIME Coal Division, presided. The speaker was George E. Whitwell, vice-president, Philadelphia Electric Company, Philadelphia, Pa., whose subject

was "Competitive Aspects of the Utility Business."

Gas Analyzers

At the first technical session, C. H. Barnard, Bailey Meter Company, Cleveland, Ohio, presented a progress report on "Gas Analyzers for Better Combustion." Although gas analyzers have been applied successfully to such equipment as coal fuel boilers, kilns, open-hearth furnaces, and continuous-strip annealing furnaces, there are still problems to be overcome, he said. Discussion brought out the need for additional information on the interpretation of the results given by gas analyzers. It was suggested that more information be published on the maintenance of gas-sampling lines.

At the same session five other speakers explored various aspects of coal characteristics affecting burning equipment. The speakers and their topics were: J. S. Bennett, American Engineering Company, underfeed stokers; Robert Curfman, Cleveland Electric Illuminating Company, pulverized coal; Earl Beckwith, Detroit Stoker Company, on spreader stokers; Harry Huston, Johnston-Jennings Division of Pettibone-Mulliken Corporation, chain-grate stokers; and Frank X. Gilg, Babcock & Wilcox Company, cyclone furnaces.

At the afternoon session H. A. Baldwin, General Motors Corporation, Detroit, Mich., discussed "The Causes and Probable Effects of Today's Fuel Situation." Mr. Baldwin mentioned the history of the coal industry and stated that the advent of pulverized coal and the growth of electric generation had been very important outside influences on the growth of the industry. He called for closer attention to the desires and needs of the consumer and indicated that research, such as that on complete gasification, would be needed to insure markets.

The second paper was "A Pattern for Sound Utility Fuel Procurement," by Marshall Pease, Jr., and R. J. Brandon, both from The Detroit Edison Company, Detroit, Mich.

Mr. Brandon outlined the method used in selecting and evaluating the fuel to be burned. If coal is chosen, he said, a further evaluation must be made from (1) coal from one field and (2) coal from competitive fields. Sample cars of coal are obtained and the coal is completely analyzed, ash-fusion temperature and moisture content being most important.

Mr. Brandon presented data which have been accumulated over the past ten years. These data, presented in graphic form, showed yearly averages of heating value, ash content, coal consumption, coal storage, and comparative prices of coal and No. 6 fuel oil over this period. Another graph showed the portion of coal costs which mine price, freight charges, and operating expense represent in burning coal from competitive fields.

Mr. Pease concluded the paper by outlining the four problems facing the coal industry: (1) Lowering operating costs by mechanical methods while maintaining low ash and low water content; (2) handling coal during the winter; (3) labor relations; and (4) governmental controls.

In the discussion it was brought out that some small coal operators are mistakenly trying to improve preparation when actually they are increasing the water content more than they are decreasing ash control.

Coal Sampling

At the Wednesday morning session B. A. Landry, Battelle Memorial Institute, Columbus, Ohio, presented a paper on "Coal Sampling by Large Increment Weights," of which W. W. Anderson, Commercial Testing and Engineering Company, Charleston, W. Va., was coauthor. This paper described a sampling experiment that was aimed at determining the variance in percentage ash of large-weight, single-increment samples of an Indiana coal. The observed variance was broken down into its component parts which were calculated from the data obtained. Results showed that for increments of large weight, such as are taken by mechanical samples at steam-generating stations, relatively few would be required for the coal studied to obtain a gross sample meeting present accuracy standards. The suggestion was made that studies on other coals should be made to confirm these findings which, if generally true, might lead to an upward revision of the standards of accuracy in view of the practicability of mechanically taking larger numbers of increments.

The second paper was by Arthur L. Bailey, U. S. Bureau of Mines, and B. A. Landry, Battelle Memorial Institute, on "The Effect of Coal Size on the Sampling of Coal for Float-and-Sink Tests."

This paper discussed the problem of reduction in weight of a gross sample of coal by subdivision to a convenient weight for laboratory handling without loss of accuracy. The problem is not facilitated by the imposed requirement that, in float-and-sink control work, the coal must not be crushed but may only be additionally mixed before subdivision. Data were presented giving the variance of laboratory samples after a fairly elaborate mixing procedure for four double-screened sizes of a Western Pennsylvania bituminous coal. The authors presented a general method for relating the variance found to the sampling characteristics of the coal in terms of the fractions contained of float, middling, and sink materials.

Fine Coal

At the final session, three papers dealing with coal preparation were presented. Shiou-Chuan Sun, Pennsylvania State College, presented a paper on "Frothing Characteristics of Pine Oils in Flotation." This paper described the frothmeter which was used to measure the volume and persistence of froth as well as the volume of air bubbles entrapped in the liquid. Using this frothmeter, data were obtained on the frothabilities of the different grades of pine oil and its principal chemical components under various conditions. The data indicated that the important factors influencing the frothability of pine oil are: (1) chemical composition of the pine oil; (2) pH value of the solution; (3) rate of aeration; (4) time period of aeration; (5) temperature of solution; and (6) concentration of pine oil in solution.

D. W. Gillmore, Pennsylvania State College, next presented a paper on "Drainage Behavior and Water-Retention Properties of Fine Coal," of which C. C. Wright of Pennsylvania State College was coauthor. This paper discussed dewatering phenomena in an effort to obtain

AT THE BANQUET OF THE 13TH ANNUAL AIME-ASME JOINT FUELS CONFERENCE, HOTEL STATLER, CLEVELAND, OHIO, OCT. 25, 1950

(*Left to right:* Clayton T. Elder, chairman, Executive Committee, Fuels Division, Cleveland Engineering Society; E. D. Benton, general chairman, Ohio Coal Association; John F. Barkley, U. S. Bureau of Mines, who received ASME Fellow Certificate; Julian E. Tobey, president, Appalachian Coals, Inc., 1950 recipient of Percy Nicholls Award; E. G. Bailey, past-president and Hon. Mem. ASME; Elmer Lindseth, president, Cleveland Electric Illuminating Company; T. A. Marsh, toastmaster, Iron Fireman Manufacturing Company, Cleveland, Ohio, who received an ASME Fellow Certificate; A. A. Potter, dean of engineering, Purdue University; Elmer Kaiser, chairman, ASME Fuels Division; Carroll Hardy, chairman, AIME Coal Division; William Mittendorf, Holmes-Darst Coal Corporation, who received a Fellow Certificate; and John R. Brown, president, Reliance Gage Column Company, Cleveland, Ohio, who received ASME 50-Year Membership Award.)

a guide for the evaluation and selection of dewatering procedures. Laboratory tests were performed in vertical glass columns, four to eight feet in height and with two, three, and six-inch inside diameters. From the data obtained in the tests, the following conclusions were made: (1) A column of drained coal divides into three zones, a high-moisture zone at the bottom, a low-moisture zone at the top, and a transition zone between them; (2) the water-retention pattern is established in a few hours; (3) the moisture-distribution pattern depends primarily on the size consistency of the material; (4) the rate and amount of water draining from a column of saturated coal increases with average particle size; (5) careful blending of coarse coal with fine coal prior to dewatering decreases the height of the high-moisture zone and the percentage of moisture retained; (6) removal of the low-moisture region of a drainage bunker results in a lower moisture product; (7) the best bedding material is a suitable depth of the coal being dewatered; and (8) wetting agents decrease the moisture in the column but they do not increase drainage rate. Because of the excessive quantity required, the use of wetting agents does not appear economically feasible.

The third paper was by H. F. Yancey, M. R. Geer, and J. D. Price, U. S. Bureau of Mines. Its subject was "An Investigation of the Abrasiveness of Coal and Its Associated Impurities." Mr. Yancey explained the laboratory procedure used to estimate the abrasiveness of coal. In this method, a set of blades was revolved for a fixed number of revolutions in a charge of coal and the loss in weight by the blades was used as a measure of the coal's abrasiveness. Such variables as rotor speed, duration of rotation, weight and size of coal used, and clearance between the wearing blades and the walls were investigated.

Holding these variables constant, tests could be reproduced within 3 per cent for very abrasive coals and within 18 per cent for coals which were not very abrasive.

In addition, the impurities were separated from the coal by the float-and-sink procedure and were tested for abrasiveness. Whereas coal had ranged from 10–150 milligrams weight lost, the impurities gave weight losses ranging from 300–2850 milligrams.

Reported by C. W. Porterfield, Jun. ASME, Research Engineer, Battelle Memorial Institute, Columbus, Ohio.

ASME Calendar of Coming Events

April 2–5,
ASME Spring Meeting, The Atlanta Biltmore, Atlanta, Ga.
(Final date for submitting papers was Dec. 1, 1950)

April 16–18
ASME, Region VIII, Annual Meeting, Hotel President, Kansas City, Mo.

April 17–19
ASME Process Industries Division Conference, Lord Baltimore Hotel, Baltimore, Md.
(Final date for submitting papers was Dec. 1, 1950)

June 11–15
ASME Semi-Annual Meeting, Hotel Royal York, Toronto, Ont., Can.
(Final date for submitting papers—Jan. 1, 1951)

June 25–29
ASME Oil and Gas Power Division Conference, Baker Hotel, Dallas, Texas
(Final date for submitting papers—Jan. 1, 1951)

Sept. 10–14
ASME Industrial Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Houston, Texas
(Final date for submitting papers—May 1, 1951)

Sept. 24–26
ASME Petroleum Mechanical Engineering Conference, Hotel Mayo, Tulsa, Okla.
(Final date for submitting papers—May 1, 1951)

Sept. 25–28
ASME Fall Meeting, Hotel Radisson, Minneapolis, Minn.
(Final date for submitting papers—May 1, 1951)

Oct. 11–12
ASME Fuels and AIME Coal Joint Conference, Roanoke, Va.
(Final date for submitting papers—June 1, 1951)

Nov. 25–30
ASME Annual Meeting, Chalfonte Haddon Hall, Atlantic City, N. J.
(Final date for submitting papers—July 1, 1951)

(For Meetings of Other Societies see page 1025)

ASME Standards Workshop

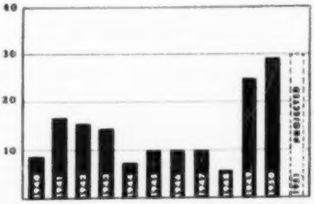
Pressure Piping

THE final draft of a revision of the Code for Pressure Piping was released for printing by the Executive Committee of ASA Sectional Committee B31 at a meeting in the Engineering Societies Building, New York, N. Y., Oct. 18, 1950. The present code was published in 1942 with supplements 1 and 2 following in 1944 and 1947. In 1948 Sectional Committee B31 was reorganized and set about to bring the 1942 code up to date. This involved including in the revised code new materials capable of meeting industrial requirements for pressure piping. The approved draft will now be submitted to the ASME Board on Codes and Standards, administrative sponsors of the Sectional Committee. Later the proposed revisions will be submitted to the American Standards Association for designation as an American Standard.

Ahead of the Committee are two projects which are to be undertaken in co-operation with the ASME Boiler Code Committee. They are: (1) Working up a standard for qualifying welders of pressure piping, and (2) examining the basis for establishing maximum allowable working stresses for materials used in boiler construction and pressure piping. The Committee also expects to undertake a comprehensive revision of the Code in two or three years.

Drill Drivers

A PROPOSED standard on split-sleeve collet-type drill drivers was recently submitted to the Sectional Committee B5 on Small Tools and Machine Tool Elements for letter-ballot



NUMBER OF CODES AND STANDARDS NOT INCLUDING BOILER CODES PUBLISHED BY THE ASME, 1940–1950

(The significant increase in the number of codes published in the last few years indicates increasing acceptance by industry of codes and standards developed by ASME.)

approval. The proposed standard had been before industry for comment since May, 1950.

The standard was developed because the assembly of drill and collet-type driver requires drivers manufactured to close tolerances to insure that collets fit standard drill shanks.

While various methods and mechanisms are used in American industry to drive twist drills, the split-sleeve collet has been particularly popular in the automotive and other mass-production industries for two reasons: (1) Multiple-spindle drill heads can be designed with spindles on a very close center-to-center distance; and (2) bushing plates do not have to be moved when drills are replaced. The split-sleeve collet driver is designed to drive straight-shank drills. In sizes larger than $^1/_8$-drill diameter the drill shank is tanged to insure proper functioning.

In its foreword, the Committee explains that the proposed standard is not intended as a recommendation of the split-sleeve collet driver. The need for the standard exists only because this type of drive needs close tolerances. No such need exists for other drill drivers for straight-shank drills.

Compressed-Air Machinery

THE reorganization meeting of the Committee for Safety Code for Compressed-Air Machinery was held at the Engineering Societies Building, Oct. 23, 1950. Vice-Chairman George P. Keogh, industrial code referee, New York Department of Labor, New York, N. Y., presided. The task before the Committee is to expand the present code for compressed-air machinery, issued in 1939, to cover all types of compressed-air machinery for all applications.

The committee reviewed comments from industry on revision of the present code and appointed subcommittees to undertake draft of revised sections.

Nuts and Bolts

MORE THAN 30 members of Subcommittee 2 and 5 of Sectional Committee B18 on Dimensional Standardization of Bolts, Nuts, Rivets, and Similar Fasteners met together at

the Carter Hotel, Cleveland, Ohio, Oct. 12 and 13, 1950, to review final drafts of proposed revisions to the 1941 American Standard on Head Bolts and Nuts and Wrench Openings and the 1939 American Standard on Round Unslotted Head Bolts. J. S. Davey, Russell Burdsall, and Ward Bolt and Nut Company, Port Chester, N. Y., presided on Thursday, October 12. H. W. Robb, standards division, General Electric Company, Schenectady, N. Y., presided at the meeting on October 13.

The members were saddened by the announcement of the death of George S. Case, chairman of board, the Lamson and Sessions Company, Cleveland, Ohio, on Oct. 10, 1950. Mr. Case, a member of the Sectional Committee B18, had been active in ASME standards work for more than twenty years. The meeting recessed Friday afternoon so that members could attend Mr. Case's funeral after adopting the following resolution: "Resolved that in his death the Committee lost invaluable service, inspirational leadership, sound judgment, humanitarian philosophy, an ardent worker, and a balancing influence which harmonized the viewpoints of his associates. Members of the Committee will endeavor to carry on in accordance with his ideals. Members extend their deepest sympathy to the family of Mr. Case, and to the Lamson and Sessions Company."

Wire and Sheet-Metal Gages

SECTIONAL Committee B32, Wire and Sheet-Metal Gages, was reorganized at a meeting on April 25, 1950. As the first order of business, I. V. Williams was elected chairman of the Sectional Committee. It was decided at that time to revise the standard for thin flat metals to include the 40 series of preferred numbers and to send it to industry for comment. It was also agreed that reference should be made to the 80 series as an appendix to this standard.

It was also decided that the Standard Sizes for Wire will be changed to the title "Standard Sizes for Wire for Mechanical Purposes" since the use of the American Wire Gage is so widely accepted for wire used for conductors.

The proposed revision is now before industry for comment. For copies write to ASME Standards Department, 29 West 39th Street, New York 18, N. Y.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, Oct. 18, 1950

A MEETING of the Executive Committee of the Council was held in the rooms of the Society on Oct. 18, 1950. James D. Cunningham, chairman, presided. In addition to Mr. Cunningham there were present: Forrest Nagler, vice-chairman; F. S. Blackall, jr.; Albert C. Pasini, Ralph A. Sherman, of the Executive Committee; H. E. Whitaker, Finance Committee; A. R. Mumford, vice-president; E. J. Kates, assistant treasurer; C. E. Davies, secretary, and Ernest Hartford, executive assistant secretary.

Social Security For Staff

On recommendation of the Pension Committee, social security coverage for ASME employees subject to approval of two thirds of employees was authorized.

Research Agreements

The following research agreements were authorized: (1) Investigation of basic factors such as ash, slag, and fireside deposits that affect the efficient utilization of fuel in boiler furnaces; and (2) investigation of interaction of aluminum, nitrogen, manganese, silicon, and chromium in the graphitization of steam-piping steels. The first contract is with the U. S. Department of Interior and will be administered by the ASME Research Committee on Furnace Performance Factors. The second contract is with the Battelle Memorial Institute, Columbus, Ohio, and will be administered by the Joint ASTM-ASME Committee on Effect of Temperature on the Properties of Metals.

Towne Lecturer

A. W. Robertson, board chairman, Westinghouse Electric Corporation, Pittsburgh, Pa., was selected as the Towne Lecturer for 1950. His subject is "The Individual and Free Enterprise."

Resolution of Thanks

A resolution was adopted expressing the thanks of the Society to members of the Worcester Section and others who contributed to the success of the 1950 Fall Meeting.

Certificates of Award

Certificates of award were approved for the following retiring chairmen of Sections: Morris S. Smith, Virginia; Van L. Kenyon, Eastern North Carolina; Bruce E. Sherrill, Atlanta; Hans W. Forster, Buffalo; Raymond H. Tolman, Worcester; Glen L. Morris, Chattanooga; Cedric M. Ellis, Birmingham; Francis F. Dean, Greenville.

A Certificate of Award was also approved for Frederick A. Stearns, Northeastern University, Boston, Mass., past-chairman of Student Branch Committee, Region I, "for the excellent work done by that committee under his leadership."

Use of Society Emblem

Upon request of the student branch of the University of South Carolina who wanted to let the campus know that they are ardent supporters of the ASME, authorization was granted to all student branches to display a decalcomania emblem of the ASME in cars.

Rate for MECHANICAL ENGINEERING

Upon recommendation of the ASME representatives on the EIC-ASME Joint Conference Committee, a subscription rate for MECHANICAL ENGINEERING of \$3.50 plus postage was authorized to students at Canadian schools where there is no ASME student branch but where the Engineering Institute of Canada has student members. The rate is limited to 250 copies and became effective Nov. 1, 1950.

New Library Agreement

Upon recommendation of the Society's representatives on the Library Board of the United Engineering Trustees, Inc., the revised library agreement was approved. The major change in the agreement concerns ownership of books. The original agreement provided that each Society retain as its property all books contributed by it to the library. The revised agreement provides that ownership and title to books, documents, and equipment in the library be vested in the United Engineering Trustees, Inc.

Willis H. Carrier

The Committee noted with regret the death on Oct. 7, 1950, of Willis H. Carrier, Honorary Member of the Society.

Appointments

Appointments on boards, committees, and joint activities recommended by the Organizations Committee were approved. The following presidential appointments were confirmed: Carl J. Eckhardt, ASME representative to inauguration of the president, Texas Agricultural and Mechanical College, College Station, Texas; John N. MacKendrick, ASME representative to convocation for formal presentation of university charter, Saint Bonaventure University, Saint Bonaventure, N. Y.; David B. Hopkinson, ASME representative to dedication of Kingsbury Hall, University of New Hampshire, Durham, N. H.; John K. Beretta, ASME representative to dedication of Science Hall, Incarnate Word College, San Antonio, Texas.

West Coast Seminar-Type Meetings Popular

THE seminar type of meeting used during the past season by the Southern California Section of The American Society of Mechanical Engineers in co-operation with the Institute of the Aeronautical Sciences has won the support of many West Coast engineers.

According to B. M. Craig, chairman, Aviation Instruments Committee, ASME Industrial Instruments and Regulators Division, the essentials of a seminar are: (1) A highly specialized problem of local interest; (2) a panel of speakers, each of whom explores some aspect of the problem; and (3) an audience interested in and willing to discuss the problem.

Seminars have been held on such topics as air-borne data recorders and galvanometers used in flight testing. In each seminar more than 50 engineers from 20 companies participated. Some came from points as far as Denver, Colo., and Tulsa, Okla.

Asked what steps he would recommend to program chairmen in other Sections who might want to try the seminar idea, Mr. Craig said:

1. Choose only subjects of intensive local interest.

2. Choose an unbiased chairman who knows this subject and who knows other men who in turn know the subject.

3 Provide the proper publicity to let those interested know in detail what is to be discussed.

4 Select a panel of at least three and not over ten men to give five-to-ten minute "remarks" on various phases of the subject as prearranged with the chairman. Those remarks could (*a*) review the subject; (*b*) describe the member's particular connection with the subject; (*c*) give a brief history of the subject; and (*d*) enumerate problems or questions perplexing workers in the field being discussed.

5 An off-the-record or let's-bring-it-up-and-kick-it-around attitude should be encouraged rather than a formal one. No one should be pinned down by the chairman nor should the chairman permit any other person to embarrass anyone present.

Erie Engineering Fund

THE Erie Section of The American Society of Mechanical Engineers recently turned over to the Erie Engineering Societies Council a fund of $2500 to be expended either on an engineering building, a library, a scholarship fund, or some other appropriate purpose authorized and approved by the engineering profession in Erie.

The fund was what remained of money contributed by Erie engineering interests to cover expenses of the 1949 ASME Fall Meeting held in Erie in September, 1949.

A resolution passed by the Erie Section and signed by Basil S. Cain, Dudley Selden, and Guy W. Wilson of the 1949 Fall Meeting General Arrangements Committee, allows the Erie Engineering Societies Council to invest the fund and to use income for suitable current purposes, but restricts use of the principal to some major project. The fund will be administered by the Erie Engineering Societies Council and the ASME Erie Section.

Pittsburgh Sectior Plans

NOTING that more than one half of its membership is composed of juniors, the Executive Committee of the Pittsburgh Section of The American Society of Mechanical Engineers planned the 1950-1951 season to encourage greater participation of younger members and junior members in Section activities.

On October 17, the Section held a "Junior Member Night" at the University Club, Pittsburgh, Pa. The purpose of the meeting was to bring together younger and older members of the Section. About three fourths of those who attended were juniors. Enough of the older, experienced engineers were on hand to answer many questions posed by the younger members.

Another feature of the Section's program is greater co-operation with other Pittsburgh sections of the Founder Societies and the Engineering Society of Western Pennsylvania.

In April, 1951, the Section is sponsoring a two-day mechanical-engineering conference in partnership with the Pittsburgh Section of the E.S.W.P. and the Society for the Advancement of Management, American Society of Heating and Ventilating Engineers, American Materials Handling Society, and the American Society of Refrigerating Engineers. A program of eight technical sessions dealing with Pittsburgh industries is being planned.

W. I. Collins, Babcock and Wilcox Company, Pittsburgh, Pa., is chairman of the Section.

Junior Forum

How Is Your P.D.?

A Method for Self-Appraisal

By C. M. Stanley[1]

HOW is your P.D.? How are you, a young mechanical engineer, progressing in your professional development? Not too well if you are typical. We engineers have been too little concerned with P.D. and with the steps which we must take as a group and as individuals if we are to achieve it. As a result too many young engineers tend to follow the footsteps of their predecessors and concentrate on narrow technical achievement. In doing so, they fail to give real P.D. the emphasis, the time, and the effort it deserves and requires.

What is professional development? May I submit my own definition:

> Professional Development is the process by which an inexperienced engineering graduate transforms himself into a useful and active citizen as well as a competent professional engineer.

By way of emphasis, the goal to be achieved is *both* competence as a professional engineer and usefulness as an active citizen. I am firmly convinced that engineers—as individuals and as a group—will not achieve the professional status we desire unless, and until, we supplement our substantial technical achievements with a responsible contribution to professional and social problems.

The translation of such broad and general aims of P.D. into a specific program is a difficult procedure. In the interest of clarification, let me outline nine areas of activity which contribute to professional development. These nine items can serve both to guide the young engineer and to measure his achievement toward the goal.

1 Develop specialized technical ability in your chosen field.
2 Increase your knowledge of your company, its products, and its operation.
3 Broaden your engineering knowledge.
4 Familiarize yourself with the "professional" problems of engineers.
5 Obtain engineering registration.
6 Improve your communication skills.
7 Develop skill and ability in human relations.
8 Study the economic, political, and social problems of today.
9 Practice responsible citizenship.

You may measure your present state of progress toward P.D. by scoring yourself on these nine items. Use a score of two for each of the first eight items and four for the ninth item—citizenship is that important—making a possible total of 20 points. If you have achieved an adequate level of development in a given area, give yourself two points; if you are making good progress, one point; or, if you have not started work on an item or are not interested in it, a zero. Now, if you aggregate 16 to 20 points, read no further, for your P.D. is adequate. Otherwise, let me explain the importance of these nine items.

1 *Specialized Technical Ability*. The importance of this is reasonably self-evident. We are in an age of specialization, and normally a young engineer must develop his knowledge and his ability in his chosen field as a steppingstone, even though he may later turn to the broader activities of management and supervision. Moreover, many engineers will continue their upward development in the specialized fields due either to a preference for such work; to a personality which is better suited to such activities; or to a lack of opportunity to move into management and supervision.

2 *Knowledge of Your Company*. You have chosen it and cast your lot with it. If you do not like it, move elsewhere; but as long as you stay, learn about it. Familiarize yourself with its organization; its methods, policies, and procedures; its products; its prospects and its problems.

3 *Broadening of Your Engineering Knowledge*. You cannot develop in a sealed compartment, no matter what your specialty may be. Your work comes in contact with other types and branches of engineering. Your work is a part of a whole product or project. Whether you are in research, design, production, application, sales, construction, or operation, your work is only a part of a whole. So learn more about the whole—about the other branches of engineering and the other functions in your own field that have a relationship to your activities.

4 *Awareness of Professional Problems*. Acquaint yourself with the "professional" problems of engineers in order that you may contribute to their solution and to the attainment of professional standing. Learn about registration, ethics, unification of engineering societies, ECPD, legal status of engineers, and similar items.

5 *Engineering Registration*. Become a registered professional engineer by meeting the requirements of your state, whether or not you are legally required to be registered. Registration, and the accompanying use of the term,

[1] Member ASME, partner, Stanley Engineering Company, Muscatine Iowa.
Presented at the ASME 1950 Semi-Annual Meeting, St. Louis, Mo., June 19-23.

"Professional Engineer," is one ultimate method of achieving identification in the eyes of the public.

6 *Communication Skills.* Improve your ability to use the English language, both written and oral, in an effective and persuasive manner. Blueprints, graphs, and the like are useful, but you must still sell your ideas and carry on your major communications through the written or spoken word.

7 *Human Relations.* Throughout your professional career you must work with people. During your formal education you made only a small beginning in the study of the fundamentals of human relationships. You need now to increase your ability to get along with people and to understand them. This involves study and practice; study of human characteristics, behavior, and motives; and practice in human relationships.

8 *Economic, Political, and Social Problems.* We are in a complex and confused era which questions the ability of mankind to control his own inventions. The engineer cannot continue aloof from the many economic, political, and social problems with which his community, his country, and his world is grappling. In true engineering fashion he must understand the problems before he can venture his assistance in their solution. So he must study the problems of the world, many of which were partially created by his own work.

9 *Citizenship.* I cannot overemphasize the importance of citizenship in professional development. Citizenship—whether in reference to your organization, your community, your country, or the world—involves the acceptance of responsibilities and duties along with privileges and freedoms. A good citizen is a participant rather than an observer. He helps carry the load rather than ride on the backs of others. He exercises his right to vote and is interested in local, state, and national politics. He assists in the community activities which make his town or city a desirable community for himself, his wife, and his children, such as schools, churches, youth activities, and others.

Engineer citizens have an even greater responsibility which they must assume. The problems of the world of today are, to a considerable extent, the result of mankind's misuse of the industrial machine which the engineer and the scientist have created. We engineers have given birth to this great productive civilization which can do so much to improve the health and welfare of mankind, but we have had little participation in its control. We have been too little concerned with the social and economic problems created by industrialization. We have assumed no responsibility for the increasing destructiveness of our products when they are turned to war.

For our own enlightened self-interest as well as for the good of society, we engineers must accept a greater responsibility as citizens and must render a greater service in the control and use of our "brain children." In this direction will come public recognition of professional status.

How is your P.D.? If you are progressing in all of these nine areas, you are working toward your ultimate goal of becoming a professional engineer—practicing your chosen work and earning and receiving the satisfaction and rewards that go with true professional development.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or not, and is operated on a nonprofit basis. In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office. When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York 8 West 40th St.	Chicago 84 East Randolph Street
Detroit 100 Farnsworth Ave	San Francisco 57 Post Street

MEN AVAILABLE[1]

MECHANICAL ENGINEER, industrial-engineering electives, 24, June, 1950, graduate, Clarkson College, veteran, top sixth of class. Desires opportunity in refrigeration and/or air conditioning as assistant to consulting, estimating, or production and planning engineer. Me-796.

DESIGN ENGINEER, 39, BSME, family, veteran, seven and a half years design heavy centrifugal machinery, one and a half years nonferrous foundry research, one year design and test air-conditioning systems. Desires responsible small-plant position preferably Southeast. Me-797.

MECHANICAL ENGINEER, BSME, 27, three years steam, Diesel engineering officer in Navy. Two and a half years power-plant design, installation, one and a half years pharmaceutical-plant layout, piping. Desires position in New York, N. Y., New Jersey metropolitan area. Me-798.

MECHANICAL ENGINEER, 27, BSME, 1948, married. Two years' experience in pulp mill on equipment installation, maintenance, and operation. Three years diversified board work. Prefers manufacturing industry, western Pa. or Ohio. Me-799.

SALES ENGINEER, 33, married, ME. Inside and outside experience in machinery and industrial furnaces; presently employed. Will relocate and travel. Me-800.

ECONOMIC-INDUSTRIAL ANALYST OR CONSULTANT, 38, married, ME, AB (Economics) with experience in teaching economics and cost analysis, research, material supply, administration. Decorated for wartime staff work, knows Washington. Desires opportunity to grow with company contemplating new developments, expansion, or conversion. Available immediately. Prefers West. Me-801-474-D-11.

POSITIONS AVAILABLE

DESIGN DRAFTSMEN, 22-28, mechanical or electrical graduate, for board design work on turbines, centrifugal compressors, and heavy rotating electrical apparatus, covering continuous development on machinery in regular commercial production. Salary open. Western Pa. Y-3923.

GENERAL FOREMAN, seven to ten years' experience, preferably in mass production. Knowledge of heat-treating steel, mechanics of soldering brass and copper desirable. Company manufactures automobile springs and radiators. $6600. New York State. Y-4311.

VICE-PRESIDENT, 40-48, to take full charge of the company's product development and research program. No responsibility for plant or production engineering. Company produces small valves, fittings, and a variety of metal component parts to industry. $20,000-$30,000. New York, N. Y. Y-4315.

PRODUCTION-CONTROL SUPERVISOR, 30-40, preferably industrial or electrical graduate, four to seven years' experience in production and material control, including planning and scheduling for maintenance and repair of heavy motors or railroad machinery and equipment. Will be responsible for organization and administration, planning and scheduling, production control, records, analyses, customer contacts, wage-incentive programs, cost reduction, and liaison with other departments. $5500-$6000. Conn. Y-4330.

ENGINEERS, 35-45. (*a*) Assistant chief mechanical-design engineer for large company of engineering constructors in the steam-power-plant division. $12,000-$14,000 plus bonus. (*b*) Assistant chief electrical-design engineer, as above. $8000-$10,000 plus bonus. (*c*) Project engineers, mechanical, to take complete charge of projects in the design and construction of industrial steam-power station. $8000-$10,000 plus bonus. Calif. Y-4331S.

INDUSTRIAL ENGINEER, particularly experienced in department-store work with emphasis on materials handling, warehousing, etc. $7500. Washington, D. C. Y-4354.

DESIGN DRAFTSMAN, under 40, mechanical graduate, at least ten years' experience covering mechanical and electrical trades in construction industry, to design and detail piping, plumbing, air conditioning, wiring, supports, etc. $4800-$5400. New York, N. Y. Y-4369.

PLANT MANAGER, 40-50, for company manufacturing high-pressure tanks. Must have considerable experience in steel fabrication, bending, welding, etc. $15,000-$18,000. Midwest. Y-4389.

CHIEF ENGINEER, 35-50, engineering and executive experience with machine-tool builders, preferably those who tool their machines for high production as for the automotive field. This experience should be with light and medium-weight machinery on drilling, tapping, counterboring, etc. Should have had experience on indexing-type machinery for high-production hole work where operations are done progressively. Should be a good jig-and-fixture designer. About $8000 plus bonus. Ohio. Y-4405.

DEVELOPMENT ENGINEER, mechanical or electrical degree, for manufacturer of temperature- and pressure-responsive instruments. Experience with Bourdon tubes and diaphragms desirable. Wis. Y-4411.

PLANT ENGINEER, 30-35, mechanical graduate, with experience in maintenance of rubber-mill machinery and power plant, to supervise maintenance, plan new installations, keep cost records, make power studies, etc., for rubber-goods manufacturer. $6500. Western Pa. Y-4419.

MECHANICAL ENGINEER, 32-35, with five to ten years' experience in calculations. $6500. Conn. Y-4433.

CHIEF ENGINEER, 35-45, for manufacturer of household and industrial products. Must have a mechanical degree and at least five years' experience, to do research, design special machinery, and do general engineering in design of regular industrial and household products, machinery and operations, establishment and maintenance of drawings and specifications. $10,000-$15,000. Northeast U. S. Y-4438.

METHODS ENGINEER, 30-35, minimum of five years' experience, preferably in the machine-shop practice for industrial-management work. Must be able to take blueprint and give sequence and operation. Some traveling. $6000 plus living allowance. Headquarters, New York, N. Y. Y-4444.

PLANT ENGINEER, 30-45, preferably mechanical graduate, minimum of five years' maintenance experience, to supervise plant engineering for cosmetic manufacturer. $5000-$5500. New York, N. Y. Y-4455.

ENGINEERS. (*a*) Mechanical engineer, thorough knowledge of all phases of mechanical-engineering planning and design. Should be well grounded in the mechanical features of building

(*ASME News continued on page 1036*)

[1] All men listed hold some form of ASME membership.

SEATLESS MEANS ECONOMY

IN BOILER BLOW-DOWN SERVICE

Because they eliminate the commonest source of trouble and expense in ordinary blow-off valve service, Yarway *Seatless* Blow-Off Valves mean real economy to boiler plant operators. *Yarways have no seat to score, wear, clog and leak.* Lubrication is usually the only maintenance they require.

Yarway introduced the seatless principle with the balanced sliding plunger many years ago . . . has constantly improved and adapted it to meet modern service requirements. Mechanical and metallurgical research in Yarway's own Steam Laboratory anticipates changing conditions . . . keeps Yarway valve design ahead.

There is a Yarway Seatless Blow-Off Valve for every pressure. Iron body for 50 to 200 lbs., steel body for higher pressures.

SEND FOR FREE BLOW-OFF VALVE BOOKLET. PLEASE INDICATE THE PRESSURE OF YOUR BOILERS.

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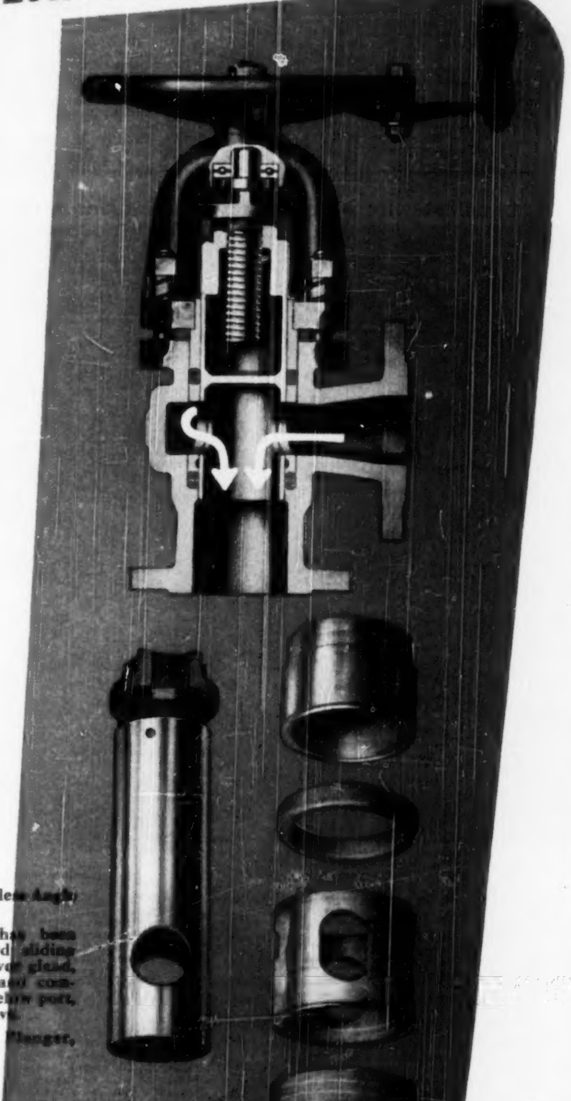


(*Above*)—Cross section of Seatless Angle Valve, flanged.

OPERATION: After valve has been closed, shoulder on balanced sliding plunger contacts upper follower gland, forcing it down into body and compressing packing above and below port, making an absolutely tight valve.

(*Below*)—Balanced Sliding Plunger, Packing Rings and Glands.

YARWAY BLOW-OFF VALVES

construction. have thorough knowledge of the selection and use of equipment, materials, methods of construction, and building costs. Will be responsible for the development and preparation of mechanical plans and design for all types of structures and projects. $4600. (b) Mechanical engineer, to be responsible for making fuel-costs studies and heat-conservation analyses for a utilities procurement division. Will furnish technical assistance to activities with respect to fuels best suited for use in fuel-burning equipment, secure the performance of check tests, and make recommendations. $5400. South. Y-4457.

ASSISTANT TO PLANT MANAGER, 35-45, mechanical graduate, at least ten years' supervisory experience covering steel-plate fabrication and heavy-machinery experience, to assist plant manager in planning regular production and handling special orders on a job-shop basis, coordinating design and material changes between engineering and shop, supervising progress records and controls, etc. $8000-$10,000. Northern New York State. Y-4474.

ENGINEERS. (a) Design engineer, mechanical graduate, at least ten years' instrument or mechanical-devices experience, to redesign for production aneroid and air-pressure instruments. $7000. (b) Assistant design engineer, mechanical graduate, with at least five years' experience, to design and detail for production purposes, mechanical instruments, and controls. $4800-$6000. Pa. Y-4479.

MYERS, J. T., Kent, Ohio
PARR, JEROME H., Dayton, Ohio
PRUPIS, ROBERT I., West Orange, N. J.
QUINN, GEORGE F., Falls Church, Va.
ROYSDON, J. P., Lorton, Va.
SALLS, DAVID M., Shreveport, La.
SANNS, JAMES J. N., Chicago, Ill.
SCHALLA, CLARENCE A., Cleveland, Ohio
SCHOMER, ROBERT T., Oak Ridge, Tenn.
SCHULTZ, J. A., Pittsburgh, Pa.
SITARSKI, A. W., Lyndhurst, N. J.
STONE, ALBERT R., Laurel, Md.
UNDERBERG, SAMUEL, Brooklyn, N. Y.
WELSH, HARVEY W., Wyckoff, N. J.
WETZEL, J. J., Detroit, Mich.
Transfers from Student Member to Junior 75

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Dec. 25, 1950, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers immediately.

KEY TO ABBREVIATIONS

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member.

NEW APPLICATIONS

For Member, Associate, or Junior

BARNEY, ROBERT E., Drexel Hill, Pa. (Rt&T)
BARNHART, ERWIN S., Del Mar, Calif.
BARTLETT, JOHN W., Peoria, Ill.
BELUE, RICHARD O., Lancaster, S. C.
BISHOP, GLENN R., Austin, Texas
BONNET, F. H., Bexley, Columbus, Ohio (Rt)
BORN, ROBERT F., Chicago, Ill.
BOWMAN, GILBERT T., Belmont, Calif.
BRAIN, JESSE, New York, N. Y.
BRINK, T. R., Michigan City, Ind.
BROGLIO, LUIGI, Rome, Italy
BROOKS, ROBERT D., Pittsburgh, Pa.
BUBB, ROBERT S., Cleveland Heights, Ohio
BURKE, JOHN G., Tulsa, Okla.
BUSCH, CHARLES R., New York, N. Y.
CASEY, HOWARD T., New York, N. Y.
COCKLIN, HUBERT W., Phoenix, Ariz.
CROWLEY, JOSEPH A., New York, N. Y.
DANI, DINAKAR P., Poona, India
DAVENPORT, T. A., JR., Grosse Pointe, Mich.
DEFRATE, L. A., Wilmington, Del. (Rt)
DELLI PAOLI, ALEXANDER, New York, N. Y.
DERESIEWICZ, HERBERT, Silver Spring, Md.
DERICK, H. A., Oswego, Ore.
DOLLHEIMER, FRANZ, Savannah, Ga.
DORTCH, JAMES H., Richmond, Va.
DREXEL, CHARLES F., Los Angeles, Calif. (Rt&T)
DROMS, CLARENCE R., Scotia, N. Y.
EBERHARDT, HENRY M., Temple, Texas
EDGAR, ROBERT F., Pattersonville, N. Y.
EDWARDS, EVAN A., Rochester, N. Y.
FRANKS, JAMES K., Forest Hills, N. Y.
FULLER, CHARLTON T., Catasauqua, Pa.
GAMBLE, CARY B., New Orleans, La.
GILLIS, ANGUS, JR., Charleston, W. Va.
GRAY, ROBERT C., Wilmington, Del.
GREENBAUM, ARTHUR, Jamaica, N. Y.
GRIGSBY, CHESTER E., Chicago, Ill.
HARVEY, J. D., New York, N. Y.
HIRS, GENE, Detroit, Mich.
HOGAN, JOSEPH R., Wichita Falls, Texas
HOYT, EARL D., Chicago, Ill.
HUMMEL, BENJAMIN L., Cleveland, Ohio
HUFFINE, K. W., New York, N. Y.
JENKS, WILLIAM F., West Roxbury, Mass.
JOHNSON, WILLIAM J., Erie, Pa.
JONES, DWIGHT E., Pittsfield, Mass. (Rt&T)
KAUFMAN, LUCILE B., Phoenix, Ariz. (Rt&T)
KEEFE, ROBERT L., JR., New Castle, Del.
KENNEDY, FRANK, Hutchinson, Kan.
KENNEDY, JAMES J., Fayetteville, Ark.
KENT, HORACE L., New York, N. Y.
KERCHAL, RAYMOND G., Lincoln, Neb.
KESSES, JOHN M., Hamden, Conn.
KIMMEL, WALTER G., Rock Island, Ill.
KINSMAN, GEORGE C., San Francisco, Calif.
KILBY, WILLIAM C., Rapid City, S. Dak.
KIRK, W. KENT, JR., Takoma Park, Md.
KUMAR, S. M., Washington, D. C.
KURLINSKI, DALE T., North Canton, Ohio
LUCAS, ROBERT L., Wilton, Conn.
LYLE, EDWARD A., Signal Mountain, Tenn.
MAXWELL, WILLIAM S., Brooklyn, N. Y.
MCGHEE, FRANK E., Chicago, Ill.
MATCHNEER, WILLIAM W., Columbus, Ohio
MILLER, CHARLES H., Chicago, Ill.
MILLS, EARLE W., New York, N. Y.
MOBLEY, LOUIS R., Endicott, N. Y. (Rt & T)
MULLER, HENRY, New York, N. Y.
MYERS, ROBERT C., Los Alamos, N. Mex.
NAFTALIN, BERNARD H., Toledo, Ohio
NAGHDI, PAUL M., Ann Arbor, Mich.
NANDEESWARAIYA, N. S., Madhugiri, Mysore, India
NORTON, ROBERT H., Coahuila, Mexico (Rt)
OWENS, LESTER J., Chattanooga, Tenn.
PETERSDORF, ROBERT J., Milwaukee, Wis.
PFLEDERER, GALEN K., Greenville, S. C.
PINCKNEY, CHARLES C., Birmingham, Ala.
PINGEL, HENRY C., Wyomissing, Pa.
POPE, R. J., London, Ont., Can.
RAND, H. J., Cleveland, Ohio
REILLY, VINCENT P., Chicago, Ill. (Rt & T)
RESWICK, MAURICE, Rutherford, N. J. (Rt)
RICHMOND, WILLIAM D., JR., Richland, Wash.
ROBERTS, JOHN A., Davenport, Iowa
ROCK, PHILIP J., Byfield, Mass.
ROBINSON, THEODORE H., Summit, N. J. (Rt & T)
RUBINSKY, STANLEY, State College, Miss. (Rt & T)
SANDO, F. A., Willow Run, Mich.
SCHMIDT, RICHARD D., Kansas City, Mo.
SHEBLE, HAROLD N., JR., Riverton, N. J.
SHERMAN, LAWRENCE, New York, N. Y.
SIMONS, ALLISON K., Milwaukee, Wis.
SINGH, IQBAL, Ruston, La.
SPARKS, HYNES, New York, N. Y.
SPERRY, CHESTER C., Kalamazoo, Mich.
STAPP, KENNETH P., Waterloo, Iowa
STONE, HERBERT P., JR., Yonkers, N. Y.
STOVALL, E. E., Dallas, Texas
SWAIN, RICHARD W., Chicago, Ill.
THOMPSON, CALVIN A., Chicago, Ill.
THOMPSON, JOEL W., Park Hills, Covington, Ky.
TILLINGHAST, JOHN A., White Plains, N. Y.
UPTON, DAVID F., St. Joseph, Mich.
WAGNER, CHARLES A., Boulder, Colo. (Rt & T)
WANSINK, LEO PAUL, Pasadena, Calif.
WENDELIN, DONALD E., Dayton, Ohio
WHITESIDE, ROBERT L., Dallas, Texas
WIDEMAN, H. C., JR., Monroeville, Ala.
WILSON, DALE G., Muncie, Ind. (Rt & T)
WISE, ROBERT T., Worthington, Ohio
WU, MING-HUA LEE, Cleveland, Ohio
YOUNG, THOMAS C., Coatesville, Pa.
ZIEBELL, A. C., Oshkosh, Wis.
ZIMMERMAN, DEWEY W., Larchmont, N. Y.

CHANGE IN GRADING

Transfers to Member and Associate

ALDAG, ROBERT, JR., Chicago, Ill.
ANDERSON, NORMAN K., Beloit, Wis.
BAINBRIDGE, HAROLD, Trenton, N. J.
BAISCH, STEPHEN J., Kaukauna, Wis.
BAKER, RALPH D., Salt Lake City, Utah
BEICHLEY, F. WENDELL, San Francisco, Calif.
BISHOP, FRANKLIN G., New York, N. Y.
BOLLES, SIDNEY L., Queens Village, N. Y.
BOLZ, RAY E., Cleveland, Ohio
BREVOORT, HOWARD W., Stewart Manor, N. Y.
BUR, ARMAND, Cleveland, Ohio
BURGESS, NEIL, JR., Melrose, Mass.
CARR, JOHN H., Sierra Madre, Calif.
DONOVAN, WILLIAM J., Mamaroneck, N. Y.
FAIRCHILD, W. LEE, Corning, N. Y.
FARRAR, LEONARD, Berkeley, Calif.
FELLERS, CLARK I., Rochester, N. Y.
FERRIS, ROY M., Beaumont, Texas
FOBIAN, R. J., West Allis, Wis.
GALBRAITH, FRANK W., China Lake, Calif.
GILMER, G. WALKER, 3RD, New York, N. Y.
HALEY, ROBERT L., Winnebago, Ill.
HARKENRIDER, ROBERT J., Winona, Minn.
HILDESTAD, HAROLD L., Swarthmore, Pa.
IMSE, PHILIP J., Westfield, Mass.
KATZ, ISRAEL, Ithaca, N. Y.
LEWIS, OLIVER H., Oak Ridge, Tenn.
LIEBERG, E. O., Cloquet, Minn.
LIEBL, LOUIS, JR., Wilmette, Ill.
MARTIN, JOHN J., JR., New Haven, Conn.

Obituaries

Harry Phillip Briggs (1899–1950)

HARRY P. BRIGGS, superintendent of power, Radio Corporation of America, Camden, N. J., died in Oaklyn, N. J., Sept. 9, 1950. Born, Camden, N. J., Feb. 27, 1899. Parents, Henry P. and Lucy (Wilkinson) Briggs. Education, attended Carnegie Institute of Technology, Drexel Institute of Technology, Hays School of Combustion Engineering. Married Marie Elizabeth Sangro, 1932. Assoc. ASME, 1946. Survived by wife and four children, Regina, Sister Mary Fides, Meadowbrook, Pa.; Harry P., Jr., Philadelphia, Pa.; Kenneth C., Lindenwold, N. J.; and two grandchildren.

Joseph Aldrich Bursley (1877–1950)

JOSEPH A. BURSLEY, dean emeritus of students and professor emeritus of mechanical engineering, University of Michigan, died in University Hospital, Ann Arbor, Mich., Sept. 4, 1950. Born, Fort Wayne, Ind., June 14, 1877. Parents, Gilbert Everett and Ellen Rebecca (Aldrich) Bursley. Education, BSME, University of Michigan, 1899. Married Marguerite Knowlton, 1908 (died 1940). Author of "Heat Engines" with J. R. Allen. Jun. ASME, 1906; Mem. ASME, 1910; Fellow ASME, 1946. Survived by three daughters, Mrs. William D. Angst, Ann Arbor, Mich.; Mrs. John S. Winder, Fort Wayne, Ind.; Mrs. Anna B. Steed, Dearborn, Mich.; seven grandchildren; and a brother, Philip E. Bursley, Ann Arbor, Mich.

Charles Harold Champion (1885–1950)

CHARLES H. CHAMPION, chairman, Ship Carbon Co. of Great Britain, Ltd., and Charles H. Champion and Co., Ltd., died in Knocke, Belgium, Aug. 30, 1950. Born, Alfriston, Sussex, England, Nov. 21, 1885. Education, Eastbourne College, Sussex, England, 1895–1899; Ardingly College, 1899–1902, Senior Oxford Examination taken and passed, 1901, matriculated, 1902; EE, Mittweida Technical Engineering College, Leipzig, Germany, 1902–1905. Held various patents concerning electric-arc-lamp carbons. Mem. ASME, 1933.

Robert Owen Collins (1926–1950)

ROBERT O. COLLINS, research engineer, Research Laboratories Division, General Motors Corp., Detroit, Mich., died in an automobile accident at Lake Simcoe, Ont., Can., Sept. 2, 1950. Born, Elyria, Ohio, July 31, 1926. Parents, Paul O. and Leonora Ann Collins. Education, BSME, Case School of Applied Science, 1946; MSME, 1947. Jun. ASME, 1947.

Herbert Nathan Dawes (1871–1950)

HERBERT N. DAWES, consulting engineer for New England, Ehret Magnesia Manufacturing Co., Valley Forge, Pa., died Aug. 14, 1950. Born, Hudson, Mass., Feb. 5, 1871. Parents, Alfred and Laura K. (Pierce) Dawes. Education, BS, Massachusetts Institute of Technology, 1893. Married Clare Singer, 1923. Mem. ASME, 1902. Survived by wife.

Ervin Moul Fitz (1872–1950)

ERVIN M. FITZ, retired electrical engineer, died July 6, 1950, at home in Worthington, Ohio. Born, Hanover, Pa., March 31, 1872. Parents, Jacob and Carrie (Moul) Fitz. Education, Rhode Island Technical Drawing School; summer school, University of Wisconsin. Married Bessie Bliss Wiggim, 1914. Invented and developed lighting systems for railway cars. Jun. ASME, 1901; Mem. ASME, 1916. Survived by wife.

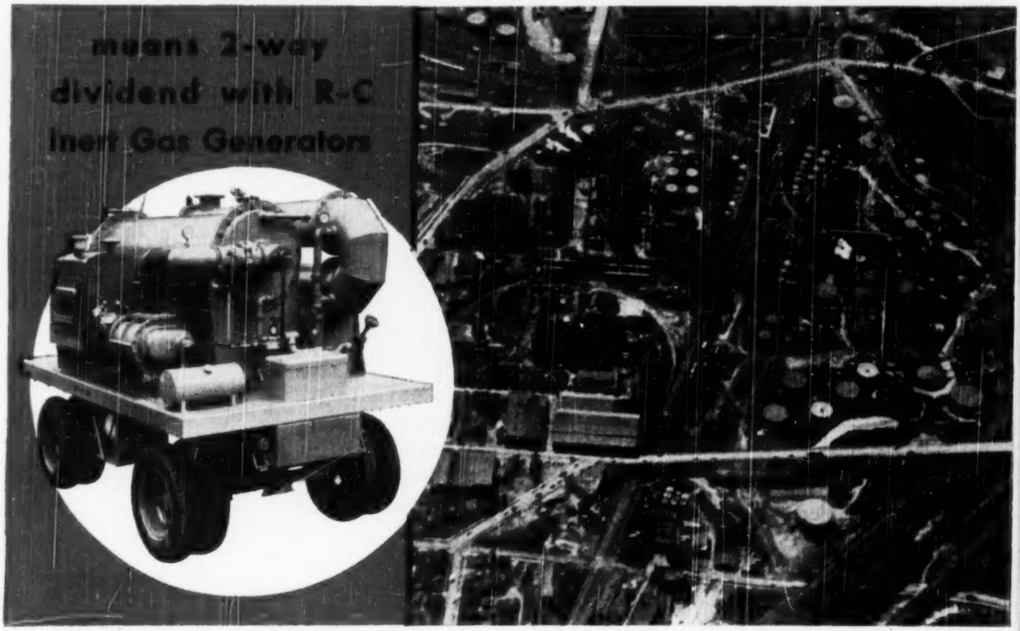
Frederick William Greve (1885–1950)

FREDERICK W. GREVE, professor, hydraulic engineering, Purdue University, died June 13, 1950. Born, Brooklyn, N. Y., July 28, 1885.

(*ASME News continued on page 1038*)

FIRE PREVENTION

plus INSURANCE SAVINGS



Savings in insurance premiums of $6,000.00 per month, and reduction of 500 different policies to three, were obtained by one extraction processor, due to the elimination of fire and explosion hazards in his three plants, essentially aided by R-C Inert Gas Generators.

Admitting that this instance is exceptional because of the size of the plants, the amount of insurance, and other factors, nevertheless it is apparent that both large and small companies may make important savings in insurance costs, and provide improved protection against business interruption and property damage, where explosion and fire hazards must exist in their processing.

Through the use of inert gas, economically generated by R-C units, hazardous plant locations can be made safer against explosion and fire, thus proving again that "an ounce of prevention is worth a pound of cure". Portable units are readily movable from one plant to another, or stationary units can be installed where such hazardous conditions must be continuously contended with.

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ROOTS-CONNERSVILLE
ONE OF THE DRESSER INDUSTRIES

Parents, F. W. and Elmira F. (Ertel) Greve. Education, BSME, University of Wisconsin, 1908; ME, 1909. Married Florence R. Roehm, 1911; children, Elmira Ann, Frederick William, Jr. Inventor of an improved type of pitometer; parabolic weir. Author of many technical papers. Mem. ASME, 1943.

Albert Guldenbecker (1910–1949)

ALBERT GULDENBECKER, engineer, American Car and Foundry Co., Chicago, Ill., died in 1949. Born, Chicago, Ill., Aug. 6, 1910. Education, attended Armour Institute Evening School for two years. Jun. ASME, 1947; Mem. ASME, 1949.

Clifford Aylward Hahn (1889–1950)

CLIFFORD A. HAHN, president, Holtzer-Cabot Division, First Industrial Corp., Boston, Mass., died Aug. 11, 1950. Born, New York, N. Y., Jan. 4, 1889. Parents, William Christopher and Anne Francis (Doran) Hahn. Education, BSCE, Brown University, 1913; postgraduate study, Columbia University and University of Pennsylvania. Married Grace Arlene Hitchcock, 1916; children, Grace Aylward, Clifford Hitchcock. Author of many technical articles. Assoc-Mem. ASME, 1920; Mem. ASME, 1933. Survived by wife and children.

Elmon Lawrence Hall (1881–1950)

ELMON L. HALL, industrial engineer and retired vice-president (1949), Portland (Ore.) Gas and Coke Co., died Sept. 1, 1950. Born, Leadville, Colo., Nov. 29, 1881. Education, BA, Stanford University, 1902. Mem. ASME, 1925. Survived by widow, Gertrude B. Hall, to whom he was married in 1906, and four children, Mrs. Glenn Voorhies, Corvallis, Ore.; Mrs. Rodney T. Jeffrey, Portland, Ore.; Norman Elmon, Richard Lawrence, both of Portland; and four grandchildren.

Benedict John Isidin (1895–1950?)

BENEDICT J. ISIDIN, whose death was recently reported to the Society, was a mechanical engineer, The White Motor Co., Cleveland, Ohio. Born, Saratov, Russia, Feb. 25, 1895. Education, ME, Naval Engineers and Architects Academy, Kronstadt, Russia, 1916. Naturalized citizen of U. S. Author of papers published in technical journals. Mem. ASME, 1931.

Clarence Evelyn Kinne (1869–1950)

CLARENCE E. KINNE, retired 1940, chief engineer and president, Bagley and Sewall Co., Watertown, N. Y., died Sept. 13, 1950. Born, Utica, N. Y., April 16, 1869. Parents, Oliver Evelyn and Margaret (Cessford) Kinne. Education, public schools and special courses in mechanical engineering. Married Della L. Brewster, 1890. Mem. ASME, 1899. Survived by wife and daughter, Margaret C.

James Pleasants Moore (1915–1950)

JAMES P. MOORE, structural engineer, U. S. Bureau of Reclamation, Redding, Calif., died Aug. 10, 1950. Born, Muskogee, Okla., March 10, 1915. Parents, Thomas Lake and Martha (Hill) Moore. Education, BSME, Georgia Institute of Technology, 1940. Married Rita Weiderhold, 1942. Jun. ASME, 1948. Survived by wife and his parents.

Olin Simmers Pfeiffer (1903–1949)

OLIN S. PFEIFFER, engineer, Alliance Machine Co., Alliance, Ohio, died June 17, 1949. Born, Gnadenhutten, Ohio, April 23, 1903. Parents, Adam and Mary (Simmers) Pfeiffer. Education, BSME, Ohio Northern University, 1927. Married Edna Shull, 1928. Mem. ASME, 1943. Survived by wife and three children, Mary Lee, Harry, and David.

Leo Ranney (1884–1950)

LEO RANNEY, president, general manager, Ranney Oil Mining Co., chairman of board, Ranney Water Collector Corp., died Sept. 15, 1950, in Morro Bay, Calif. Born, New Hartford, Iowa, Aug. 26, 1884. Parents, Wallace Austin and Adelaide (Clayton) Ranney. Education, BDi, Iowa State Teachers College, 1905; BS, Northwestern University, 1911. Married Clair Sussex Fairbanks, 1927; stepsons, Charles O., Henry, Robert Fairbanks. Designer and builder of largest water well; driller of first hydraulic oil well. Inventor of Ranney water mining processes: oil from exhausted fields; of converting coal to gas without mining; of forming underground-gas-storage resevoirs; of degasification of unmined coal; of excavating and earth-moving processes and machinery. He held over 200 patents. Contributed technical articles to many American and European journals. Mem. ASME, 1940. Survived by wife.

Allen Arthur Raymond (1886–1950)

ALLEN A. RAYMOND, superintendent, Fuel and Locomotive Performance, New York Central Railroad, Buffalo, N. Y., died in Westport, Conn., Aug. 30, 1950. Born, Troy, N. Y., Nov. 19, 1886. Parents, Lewis Wasson and Charlotte E. (Sherry) Raymond. Education, BSME, Cornell University, 1910. Married Marietta Persch, 1913. Mem. ASME, 1931. Fellow ASME, 1948. Served on ASME Railroad Division Membership Committee, Research Committee on Furnace Performance Factors and its subcommittee Properties and Fuel Ash and Slag. He was vice-president, Air Pollution and Smoke Prevention Association of America. Author of several papers on railroad engineering. Survived by wife and two children, Mrs. Susan (Thompson G.) Marsh, Denver, Colo., and Allen A., Jr., Westport, Conn.

Walter Reichen (1899–1950)

WALTER REICHEN, mechanical engineer in charge of boiler construction, Sunbury, Pa., steam-electric station, Electric Bond and Share Co., died July 18, 1950. Born, Frutigen, Switzerland, Sept. 14, 1899. Parents, Adolf and Marie (Reider) Reichen. Education, attended Bern Technicum, Switzerland. Naturalized U. S. citizen. Married Anna Mary Shultz, 1931. Mem. ASME, 1950. Survived by wife and two children, Frances Anne and Cameron Walter.

Arthur Scrivenor (1866–1950)

ARTHUR SCRIVENOR, consulting engineer, patent attorney, Richmond, Va., died Sept. 8, 1950. Born, Alvingham, Lincolnshire, England, April 7, 1866. Parents, Arthur and Mary Elliot (Brooks) Scrivenor. Education, St. George's School, Kings College, London, England. Married Lucy Cargill Pegram, 1898. He was choir director for 58 years at Holy Trinity Church and its successor, Grace and Holy Trinity, Richmond, Va., and director, Wednesday Club Chorus. Mem. ASME, 1901. Survived by wife and son, Arthur, Jr., Durham, Conn., and four grandchildren.

Robert Fenton Simpson (1918–1950)

ROBERT F. SIMPSON, mechanical engineer, department of applied mechanics, Stanford Research Institute, Stanford, Calif., died July 21, 1950, at Menlo Park, Calif. Born, Kansas City, Mo., April 25, 1918. Parents, Charles Hoyt and Lucia Hoyt Simpson. Education, BSME, University of Missouri, 1941. Mem. ASME, 1950. Survived by his mother.

Lawrence York Spear (1870–1950)

LAWRENCE Y. SPEAR, chairman of board, Electric Boat Co., Groton, Conn., died at his home in New London, Conn., Sept. 26, 1950. Born, Warren, Ohio, Oct. 23, 1870. Parents, William Thomas and Francis Eliza (York) Spear. Education, graduate, U. S. Naval Academy, 1890; BS, University of Glasgow, Scotland, 1893. Married Lillian Wing, 1902. He was instrumental in insuring the creation of the nucleus of a U. S. submarine fleet in the period before the first world war and was personally credited with six patented basic designs which are an integral part of all modern U. S. submarines. Mem. ASME, 1915. Survived by wife and a brother, Frederick R. Spear, Geneva, N. Y.

Arthur Hobart Taylor (1894–1949)

ARTHUR HOBART TAYLOR, partner, The Garden Woodcraft Co., Culver City, Calif., died Dec. 20, 1949. Born, Princeton, Ind., Feb. 3, 1894. Education, attended Purdue University. Mem. ASME, 1946.

Edwin Silas Wells, Jr. (1902–1950)

EDWIN S. WELLS, JR., sales engineer, turbine department, General Electric Co., Chicago, Ill., died at West Suburban Hospital, Oak Park, Ill., on Sept. 10, 1950. Born, Chicago, Ill., Feb. 24, 1902. Parents, Edwin Silas and Bertha (Bangs) Wells. Education, BSME, University of Illinois, 1923. Married Catherine Newton, 1928. Mem. ASME, 1942. Survived by wife and two children, Judith and Jonathan Silas.

Walter Joseph White (1882–1950)

WALTER J. WHITE, Balboa Heights, Canal Zone, died July 7, 1950. Born, Port Elizabeth, South Africa, June 12, 1882. Education, high school. Naturalized U. S. citizen. Mem. ASME, 1936.

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We don't Sell Your Customers

WOLVERINE TUBE

WE CARRY TUBE TO YOU

WE CARRY TUBE TO YOU

One of our prospects (prior to becoming a customer) asked us whether we would sell tubing to him and also accept orders for tubing from *his* customers.

We shouted an emphatic "No!"

That question is often asked by those who select concerns to supply material as components of their finished products or for sale over their counters.

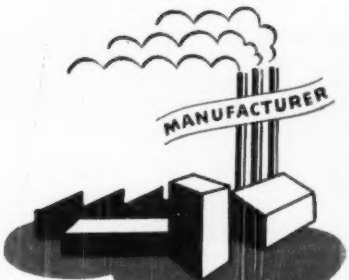
Over many years we have maintained a definite policy of *not* competing with our customers. We try to protect their interests for we sincerely appreciate the relationship we have with them.

As a customer, you can feel free to come to us for any help you need, knowing that your problems can be discussed with us in strict confidence.

If you're our customer, we like that. And we're not your competitor, so *you* like that.

Let us be of help to you.

YOU CARRY ON FROM HERE



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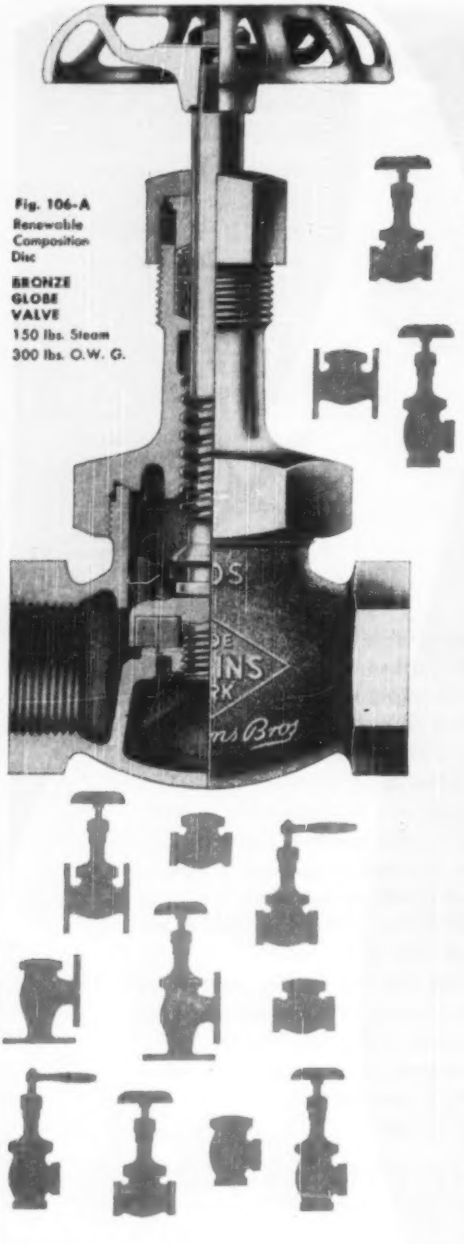


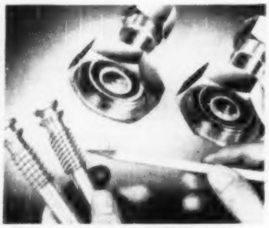
All these Valves .. from One!

Valve combinations for 90% of industrial piping assembled with 4 bodies and a handful of parts.

JENKINS FIG. 106-A "FAMILY"

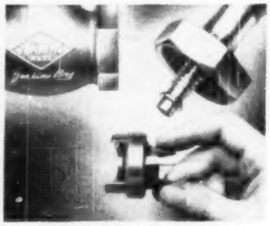
Start with the standard Fig. 106-A. Trimming is interchangeable in Globe or Angle body, screwed or flanged.

For Close Control — In throttling service, the nut which holds the disc in the disc holder is removed and replaced with Throttling Nut, Fig. 344.



For Quick Opening and Closing — Merely substitute the bonnet and spindle from Fig. 941, in which threads are pitched more sharply.

For Lift Check Service — Globe or Angle Bodies can be fitted with interchangeable Cap, Disc Holder, and Guide Disc Nut from Fig. 117A. Addition of spring from Fig. 655A provides spring loaded service.



For Stop & Check Service — Use the 106A trim, but substitute this spindle from Fig. 630A and replace the regular disc nut with the check valve guide disc nut.

Look over these pictures and see how easy it is to make up just the valve type you need, simply by interchanging parts. Think of the saving this means in maintenance expense . . . in reduced inventory of spare valves in your stockroom.

That's a big reason why the Fig. 106-A series takes top honors in any poll for valve preference. And Jenkins time-proved design, makes them the longest-lasting, lowest-upkeep valves that money can buy.

For example, see the heavy construction of the one-piece, screw-over bonnet. You can remove and replace it over and over again without distortion. See the extra size packing box,—and the perfectly machined threads on the heavy manganese bronze spindle, with more threads in contact with the bonnet, open or closed.

Remember, Jenkins Bros. is the originator of the renewable composition disc valve,—the *only* manufacturer of both valves *and* discs. For drop-tight, trouble-free performance, get acquainted with the Fig. 106-A "family". Despite their extra value, *you pay no more* for Jenkins Valves. Jenkins Bros., 100 Park Ave., New York 17, N. Y. Jenkins Bros., Ltd., Montreal. Sold through leading Industrial Distributors.

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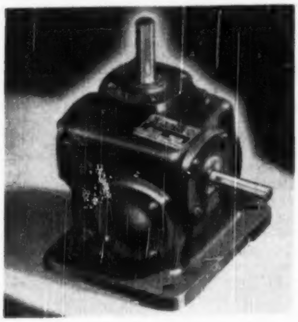
• NEW EQUIPMENT

New Winsmith Speed Reducer Stocked in 24 Assemblies

To serve fractional horsepower, small space requirements, Winfield H. Smith Corp. is now producing a new double reduction speed reducer, designated Type DBRA. This latest addition to the Winsmith line, is designed for a multitude of duties in the transmission of small power loads, and is stocked in 24 different right angle drive assemblies.



Totally enclosed in a single piece, compact housing, the low cost DBRA offers a range of 1/20—1/8 H. P. and reduction ratios of 25 : 1 to 1764 : 1. This range of speed and power, the manufacturer claims, eliminates the necessity for many users to employ bulky, expensive speed reducers that include H.P. ratings 50–100 times greater than required.

Although the DBRA was originally designed to serve the requirements of moving displays loaded with up to 1500 pounds of appliances and other merchandise, its versatility affords endless applications, according to the manufacturer. With its long lived worm gear design and Timken bearings, it is claimed, for example, to be ideal for such applications as small centrifugal fans or household fuel stokers.

New illustrated 4-page folder HW 150, with complete design and application data, is available at the Winfield H. Smith Corporation, Springville, N. Y.

G-E Installs Newly Developed Electronic Beam Let-Off Control at Van Raalte Co.

The first of two electronic let-off controls, newly developed by the General Electric Co. for tricot knitting machines, has been installed at the Van Raalte Co., Inc., Saratoga Springs, N.Y. The new device enables the mill to produce a better grade of knitted goods than was possible with mechanical controls, according to Van Raalte engineers.

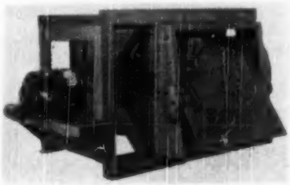
Designed to eliminate shade marks caused by short time variations of yarn tension and to give better control over "runner" length, the let-off control will provide stopping without marks on an indexed quick-stop machine.

A typical tricot type knitting machine produces flat fabric, 168-in. wide. Usually two beams in a 168-in. width machine, each containing 4704 ends of yarn full gauge down to 2352 ends half gauge, are the source of yarn fed into the machine. The tension on this yarn is considerably more than enough to turn the beams. Therefore, standard practice has been to restrain the rotation of the beam by modified automobile brakes.

All the yarn from each beam passes over its respective tension bar, the deflection of which is proportional to the tension. The motion of each tension bar controls the release of the associated beam brake. Each beam and its yarn, a tension brake and its release mechanism, constitute the closed loop of a mechanical form of servo-mechanism. The mechanical system's corrective ability, however, is not adequate to compensate for variations which occur in the brake and the change in beam diameter as yarn is paid off.

The unique principle of operation incorporated in the G-E design and the high sensitivity of the control render it unaffected by the above mentioned variation. The electronic control system utilizes a locking worm gear in place of each brake. The electronically controlled rotation of a small motor on each worm regulates the pay-off of yarn from each beam. The control signal is obtained from a position-sensing selsyn attached to the pivot shaft of each tension bar.

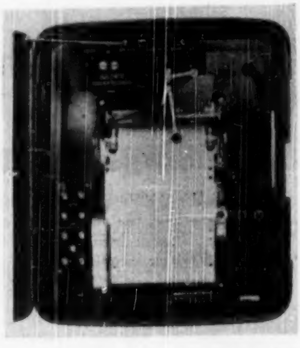
Draft Inducer with Integral Barometric



L. J. Wing Mfg. Co., 156 Vreeland Mills Road, Linden, N. J., announces a Draft Inducer with Integral Barometric for the more precise control of furnace draft. Wing Draft Inducers are now equipped with variable speed motors and can be equipped with integral barometric dampers, the combination of which permits the operator to achieve highest combustion efficiency. An important feature of the barometric is a hinged explosion gate to relieve any excessive pressures that may develop in the breeching, thus preventing damage to the heating system.

SR-4 Strain Recorder

A new Baldwin strip chart strain recorder for continuous measurement of surface strain in structures or machines by means of SR-4 resistance wire strain gages is announced by The Baldwin Locomotive Works, Philadelphia 42, Pa. The recorder is an electronic type instrument designed and calibrated for use with two SR-4 gages having a resistance of 120 ± 1.2 ohms and a sensitivity factor between 1.9 and 2.2.



Usually one gage is active and the other is used for temperature compensation but both may be active for measuring combined bending and tensile stresses or differential strains.

Available ranges in the instrument are 0-2000, 0-5000, and 0-10,000 microinches per inch. It provides ten chart speeds within a range of $^3/_4$ inch to 720 inches per hour or 12 inches per minute. The pen moves across a $4^1/_2$-inch wide chart in a straight line, thus making coordinated readings of time vs. strain simple. Instruments are available with full scale traverse speeds of one, three or five seconds without overshoot.

The pen may be zeroed at any point on the chart and the instrument range can be changed at any time during a measuring run if zero adjustment settings for all three ranges have been initially determined.

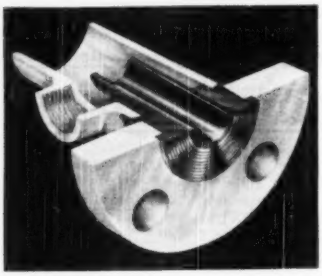
The new instrument is the counterpart of the Baldwin SR-4 Disc Chart Strain Recorder and is provided with controls and simple adjustments for gage factor, range, and coarse and fine zero settings grouped across the top of the instrument inside the door. Precision measurement of gage resistance variations is made by a 1000 cps bridge circuit. Electronic parts of the instrument are mounted on the back of the case, protected by a gasketed cover. Accuracy of measurements in all usual applications is not affected by amplifier tube characteristics or changes, or by normal power variations.

Continued on Page 42

• Keep Informed

Corrosion Resistant Heat Exchanger

A new design of heat exchanger announced by the Martin-Quaid Co., Philadelphia 32, Pa., provides corrosion resistance at a fraction of the cost of conventional alloy metal units. In addition to low cost, the new Econalloy Heat Exchanger provides a number of unique features particularly adapted to present day process piping requirements.



In the Econalloy design, corrosion resistant materials are used only where required: as flange inserts and for the inner tube which contacts the fluid or vapor being heated. An important feature is that a corrosion resistant joint is made without welding to the inner tube. The alloy inner tube is expanded into prepared serrations in the I. D. of the insert flange by special torque limit tools which prevent undesirable stresses. A positive joint is formed without the application of heat which would change the grain structure of the alloy and lower corrosion resistance.

The Econalloy Heat Exchanger also provides uniform heat over the full surface from flange to flange without dead spots. It saves space because it forms an integral part of the piping system. It can be supported vertically or horizontally along a wall, or on hangers. Used singly or in groups, Econalloy Heat Exchangers are easily demounted for cleaning, and it is simple matter to add additional capacity as needed.

The Econalloy line is furnished in sizes from a fraction of a square foot of heating surface to several hundred square feet in lengths up to 30 ft. per segment. Internal tube sizes range from 1/4" to 4". Standard units are available for pressures up to 900 lbs. per sq. inch, and temperatures in excess of 700° F.

Complete information is provided in Bulletin 9-1 available from Martin-Quaid Co., 1853 Sedgley Ave., Philadelphia 32, Pa.

Kodak Scientists Battle Motion Picture 'Dust'

A new method of determining the electrostatic charge on motion picture film may help projectionists—both amateur and professional—in winning the battle against dust.

Dust particles, attracted to film when it becomes charged with static electricity, have long been an enemy of the motion picture projectionist. For one reason, a dust speck is magnified hundreds of times when it appears on the screen.

But new apparatus and techniques developed by Eastman Kodak Co. scientists for determining the charge on film may lead to defeat of the problem.

The method is described in a scientific paper by H. W. Cleveland of the Kodak Research Laboratories in the current issue of "Journal of the Society of Motion Picture and Television Engineers."

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Basically, the problem is this: Motion picture film—or any photographic film, for that matter—becomes electrified when rubbed or passed over rollers. The electrostatic charges which are generated attract dust and dirt particles to the film.

The same thing happens when you stroke a comb rapidly through your hair. The comb will then attract small particles of paper or dust by its electrostatic attraction.

The new device developed by Kodak scientists is designed to measure accurately the electrostatic charge on photographic film. Using the apparatus, researchers can study properties of various materials used in film rollers to learn how much the film is electrified.

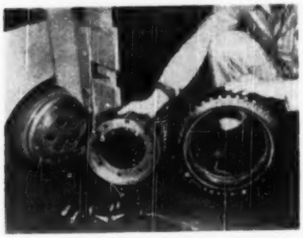
Important to the projectionist, however, are results of studies of various motion picture film cleaning materials and methods of their use. Kodak scientists used the new charge-measuring device in studies which show that film receives varying charges from different materials.

Dry velvet, for example, does not appreciably change the charge of processed Eastman Plus-X Negative Film when rubbed on either the emulsion or support side. Velvet wetted with carbon tetrachloride will hold the film at a constant charge when rubbed on the emulsion side. But when it is rubbed on the support side, the film is almost completely discharged—and thus, less likely to attract dust particles.

The technical magazine article also discusses the testing procedure in detail and supplies data on electrostatic potentials of several types of film rollers.

Demountable Cushion-Style Tires on Some Clark Models

A new demountable cushion-style rubber tire henceforth will be standard equipment on two of its fork-truck models, and on one of its towing-tractor models, according to an announcement by the Clark Equipment Company's Industrial Truck Division.



Requiring even less time to mount than a passenger-car tire, the cushion-style rubber has been set as standard for Clark's Gas Trucloader fork-lift truck in both the 1015 and 1024 models; on its new electric battery-powered Trucloader 1024 model, and on its Clarkette-5 towing tractor. It is planned to add the new tire-development to other models in Clark's fork-truck and towing-tractor lines at a later date.

This demountable tire incorporates all the advantages of cushioning, long wear, and superior cut and chip resistance found in its forerunner, which was pressed onto the wheels. It features a tapered hard-rubber base reinforced with bead wires, and it can be applied to a tapered base wheel merely by bolting together the two wheel halves with a standard wrench found in any tool kit; an Allen wrench is used to remove plugs.

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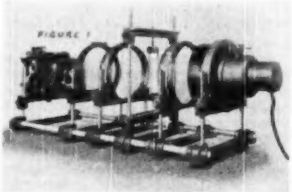
In test runs, mechanics totally unfamiliar with the new demountable cushion-style tires have been able to remove a used set and mount a new set in fifteen minutes. This contrasts with the several hours required to remove and replace the usual type of pressed-on solid tires.

Standard solid and pneumatic tires will be available for the Trucloader models as optional equipment, according to the Clark announcement. This tire is available for export sale.

Polariscope for Dynamic Stress Measurements

General Radio Co., Cambridge, 39, Mass. announces the new Type 1534-A Polariscope, an instrument for viewing and photographing stress patterns in plastic models by polarized light. A high-speed, high-power, stroboscope-type lamp is used as the light source, which gives this instrument four important advantages over other types: (1) the brilliant, short flash of the lamp arrests rapid motion, so that photographs of stress patterns can be made under dynamic conditions; (2) the short exposure (.00004 second) eliminates the necessity of massive, vibration-proof construction, so that the entire assembly is light in weight and correspondingly low in cost; (3) the light is rich in the blue end of the spectrum, permitting the use of process film, for high photoelastic sensitivity and freedom from fogging under incandescent light, and (4) the powerful flash permits the use of a large (8-inch) field.



The Type 1534-A Polariscope is made up of several subassemblies all tied together horizontally by two shafts to form an optical "bench." The light beam traverses, in order, a diffuser, a polarizer, the model mounted in a straining bridge, an analyzer, a filter, and terminates in the camera, mounted on a camera bridge. The diffuser accepts either the Strobolume lamp housing (Figure 2) or the incandescent light source (Figure 1) for steady visual observation. The polarizer-analyzer assemblies are identical. Both mount a plane polarizer and quarter-wave retardation plate, removable without tools, mutually rotatable, and registering for right- or left-hand circular polarization. Plane polarizers carry a degree scale calibrated from zero to both plus and minus ninety degrees for isoclinic (loci of equidirectional stresses) determination. The Type 1534-P4 Camera Bridge has a captive 1/4" × 20 thumbscrew for mounting the user's camera by means of its tripod socket.

All elements are horizontally adjustable along the Type 1534-P7 Shafts and vertically adjustable over some nine inches. Vee and flat ways insure optical alignment. Thumb screws hold desired settings. The bases of all components are provided with mounting holes for use when the Type 1534-P7 Shafts are not required.

In experimental physics and in mechanical engineering the Type 1534-A Polariscope has many applications. One of the most

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significant uses of photoelasticity is found in the growing tendency to study the effect of fillets and other stress-relieving contours in suitable photo-elastic models. The dramatic reduction in the number of fringes surrounding points of stress concentration effected by apparently minor contour changes offers designers a convenient tool for the rapid determination of the optimum compromise that so often determines the most successful design.

Models must be made from materials that are photoelastic, i.e., that exhibit the property of optical double refraction when subjected to mechanical loading. The best material is water-white Catalin, contour-cut from sheets cast between plate glass surfaces. Adequate exposure is obtained with camera aperture of f/4.' and process film.

The straining bridge supplied is adequate for certain simple setups, but is in no way intended as an accurately calibrated straining frame. Such equipment can be obtained from a number of reliable suppliers or can be devised by the user to fit his particular problems. For the study of dynamic stresses, the straining equipment must usually be devised to fit the problem. The model may be photographed at any point during cyclical loading, resonant or forced, or may be caught at the instant of failure under destructive loading. A series of photographs can show rapid cyclical motion to any desired extent, and the growth or spread of sharply delineated fringe patterns can be studied in detail.

Light construction, using aluminum for cast parts, results in an assembly weighing only 32 pounds. Overall dimensions are 36 x $14^1/_4$ x $16^1/_2$ inches.

Price is $490.00, exclusive of the Strobolume light source. Price of the Strobolume is $225.00.

Continental Can Installing New Type Press Drive

Believed to be the first industrial application of its kind, nine new General Electric drive systems with preset speed control are being installed by the Continental Can Co., Chicago, for use on lithographic metal-decorating presses.

Adding to the versatility of adjustable speed drive obtained with the G-E type ACA motor, the new automatic brush shifting mechanism allows manual selection of a preset speed. Known as the "preset speed device," the system allows the operator to preset any desired operating speed with a knob mounted either directly on the motor, or at the end of a flexible cable. A pilot motor drives the brushes to the position corresponding to the setting of the knob. Return of the brushes to the low-speed position for starting and for "trip-slow-down" is accomplished without disturbing the setting.

In operation, the speed setting knob is turned to the desired operating speed before the motor is started. The brushes, however, remain in the lowest speed position, and drive may be jogged as desired without up-

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setting the preset speed selection. When the run switch is closed, the line contractor is sealed in and power is applied to the pilot motor. Speed increase is accomplished by rotation of the brush yoke to the predetermined position, corresponding to the desired operating speed. Further adjustment of speed can be made while the motor is running by turning the knob to any desired point.

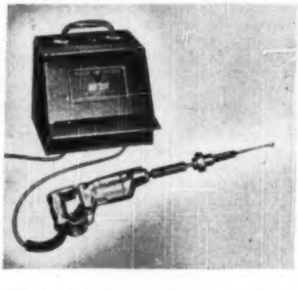
The Continental Can Co., one of the world's largest manufacturers of metal containers, is using this drive on metal lithographing presses to obtain improved speed control and wider speed range with better inherent speed regulation. The drive has been found to eliminate extensive control equipment, and to greatly reduce maintenance problems. Also, the use of this drive allows simple, yet complete co-ordination of the units following the press in the process line.

When the first trial-performance installation was made several months ago, the General Electric engineers designed a simple, effective control arrangement to co-ordinate the operation of the units following the press. The units include a coater and an oven. This was found to be very desirable, and has been incorporated with the installation of additional units. Eight of the additional units are being installed in Continental Can Company's Milwaukee plant, and the remaining unit of the nine is to be installed in the company's West Coast Plant.

The ACA motor presents an economical and space saving solution for application on these machines. The improved speed regulation over that obtained from a straight wound-rotor motor with secondary control assures close achievement of the desired speed regardless of different load conditions. Other advantages include elimination of secondary speed regulating resistors with their energy wastage and heat dissipation problem, and elimination of dial switches of contactors for commutating these secondary resistors.

New John Crane Tube Rolling Control

Announcement of a new, and greatly simplified tube rolling control has just been made by the Crane Packing Co. of Chicago. This new, electrically operated Control is low in initial cost, and because of the elimination of electronic tubes and large numbers of working parts, it practically does away with maintenance. It can be used for rolling of both ferrous and non-ferrous tubing.



Marketed under the trade name, "John Crane Control", the unit is a precision instrument designed for heavy duty service. It has only two electrical working parts, shockproof mounted and enclosed in a rugged aluminum cabinet. The electrical parts

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form a separate, easily-removed unit which can be readily replaced when necessary without special electrical skills. The entire Control unit is light in weight, and is easily moved on the job. Absence of a voltage regulator adds to the mobility.

Operation is extremely simple. Dial settings on the control panel are calibrated over a wide range of sizes and gauges, in both ferrous and non-ferrous tubing. The expanding gun is plugged into the Control unit, and the dial setting for the desired size and gauge of tube is made. Slight pressure on the handle of the gun engages the Control in the circuit. As soon as the tube is rolled to exactly the proper degree, the Control cuts off the motor. Removal of expander is also simplified; the expanding gun motor automatically reverses when pressure on the handle is released and the expander can be very easily withdrawn from the rolled tube end.

In tubes rolled by this new controlled method, over expanding of tube ends is eliminated, with consequent reduction of cold worked stresses, tube-end thinning and early tube failures. Radial and hoop stresses in the tube sheet are eliminated because tube sheet drillings are not enlarged or distorted. Under expanding, too, is prevented, assuring tight joints on the initial test and during operation of the condensing unit.

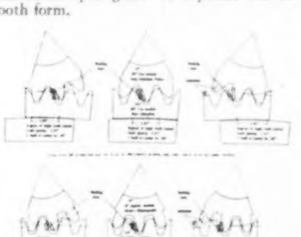
Outstanding advantages of the John Crane Control, over other controlled tube rolling methods are: only two electrical working parts; no electronic tubes; light weight and absence of voltage regulator; automatic alignment; elimination of maintenance.

A complete line of standard and long reach ball bearing thrust collar tube expanders are also available from the manufacturer. A new booklet describing these developments and outlining the operating steps is offered. Write, Crane Packing Co., Dept. M-25, 1814 Cuyler Avenue, Chicago 13, Illinois.

New Gearing for Reduced Wear

New Gearing designed to reduce wear and vibration has been announced by Allis-Chalmers Manufacturing Co., 949 S. 70th Street, Milwaukee, Wis., as standard for its grinding mills, kilns, coolers and dryers.

The new gearing has a tooth profile generated as a true involute with a 20° pressure angle, long addendum pinion and a short addendum spur gear. It replaces the 15° tooth form.



According to Allis-Chalmers engineers, the new design has a number of advantages. With 75 percent more tooth area in contact, wear is distributed over a greater space. Its use precludes interference between gear and pinion. Because the gear tooth profile is a true involute, very accurately cut, the gear is revolved at a uniform velocity.

The 20° pressure gives 25 percent stronger pinion tooth per inch of pinion face for a

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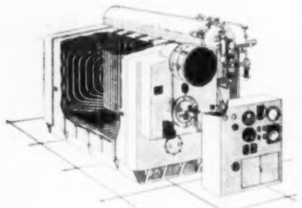
given pitch diameter. With the new gearing, a high percentage of tooth contact is rolling rather than sliding action. Then too, tooth contact pressures are reduced, permitting better lubrication.

The long addendum pinion, in addition to giving more overlapping action, also eliminates undercutting of pinion teeth.

Shop-Assembled Boiler for Unit Shipment Cuts Expenses for Small Plants

A complete shop-assembled boiler, ready to place, hook up and operate, has been added to The Babcock & Wilcox Company's line of self-contained steam generating units for power, process, and heating services. Developed to reduce the cost and time of installation work, the new boiler, shop-assembled for unit shipment, meets a definite need in both small and large establishments such as industrial and processing plants, office buildings and apartment houses, schools and hospitals, and laundries, bakeries, and dairies. Some larger plants having few skilled boiler operators may find it advantageous to use several of the smaller shop-assembled units rather than one or two of the "tailor-made" boilers which are larger and require complete field erection.



Known as the B&W Integral-Furnace Boiler, Type FM, the new unit is produced in standard sizes for loads ranging from 7000 to 25,000 lb. of steam per hour, at pressures up to 250 psi. It is a water-tube boiler, with a completely water-cooled furnace, possessing the advantages of compactness, portability, simplicity, reliability and safety, which make it different from conventional "package" fire-tube boilers. This type FM boiler is a new design incorporating all the outstanding features of the B&W series of Integral-Furnace Boilers. These, as well as subsequent "tailor-made" designs have been providing noteworthy service since 1933.

The new type boiler, requiring little space, is shipped and delivered as a unit. On arrival it is ready to skid or lift into position, hook up, and place in operation. It can be set on a concrete floor or concrete corner blocks, thereby saving in cost of building and erection. After being placed in service it can be moved from one location to another if required by plant conditions. As installation connections are limited to fuel, electricity, water, steam and stack, outage time or interference with plant operations is minimized.

This boiler is simple to operate with push-button start and stop, and automatic control for handling variations in load. It is ideal for plants whose operators attend to other essential duties. All controls are mounted on an enclosed cabinet adjacent to the front face of the boiler and are within easy reach of an attendant standing in front of the unit.

Company engineers point out that the Type FM Boiler is designed to provide all-important continuity of service. Its water-cooled furnace, designed in accordance with

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25 years' experience with other types of B&W water-tube boilers, almost eliminates maintenance. The proved arrangement of furnace and boiler heating surface assures economical fuel usage as well as dependable steam service.

Highest rates of heat transfer from the hot gases to the water in the boiler tubes are obtained through the use of two-inch generating tubes. The rapid flow of heat through the tubes to the small column of water in each tube makes the boiler a notably "fast steamer," capable of coming on the line quickly, and readily handling sudden load changes.

Firing may be by oil, gas, or combination oil and gas. Changeover from one fuel to another is easily made, so that advantage can be taken of the more favorably priced fuel.

The setting of this boiler reduces heat loss by radiation because the walls, floor and roof are lined with high-temperature block insulation and a blanket of mineral wool. The overall wall construction provides economical face temperature and comfortable work surroundings.

This boiler is also suitable for outdoor service as the entire boiler and furnace is enclosed in a rigid steel casing designed to properly permit expansion and contraction of the various components due to temperature changes.

Model 427 Differential Pressure Actuated Switch

New "Meletron" 427 Differential Pressure Actuated Switch senses a difference between a variable and reference pressure. Will make or break a circuit at any pre-set point within the Adjustable Range on increasing or decreasing pressure difference. Because the switching element is in contact with the reference pressure air or an inert gas must be used. Six (6) classes of switches provide adjustable ranges from 3 inches of water to 80 PSI with proof pressures to 120 PSI.

Pressure sensing diaphragm actuates a single pole, double throw snap-action switch when a variable pressure on one side of the diaphragm differs from a reference pressure on the other. Incorporates an Underwriter's Laboratory approved SPDT switch rated for AC and DC circuits. Ideal for maintaining a liquid level in a tank with respect to surface pressure on the liquid. On blower, ventilating, and heating ducts to sense a pressure difference; or to maintain a con-

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stant pressure in a system with respect to a reference pressure other than ambient. Switch has two pressure ports and the housing is completely sealed by "O" rings. Housing dimensions are 3" diameter and 4 1/8" overall. Weight 12 ounces. Pressure connection to 1/8-27 internal thread. Electrical connection through 1/2" conduit connector. Barksdale, 4905 Santa Fe Avenue, Los Angeles 58 California.

Di Acro Power Parter

For several years the manually operated "Di-Acro" Precision Rod Parter has been manufactured by O'Neil-Irwin Mfg. Co., 308 Eighth Ave., Lake City, Minn., and from time to time the users of this product have indicated their interest in a machine of this type with a power drive.

The "Di-Acro" Power Parter which is now being offered is an extremely high speed production machine that will easily "part-off" all types of metals in sizes up to 5/8" diameter.

Initial installations of the "Di-Acro" Power Parter made in a number of metal working plants have proven very satisfactory and from all indications this tool should find wide acceptance throughout industry.

Detailed information covering this new "Di-Acro" Product is contained in the latest edition of our 40-page catalog which is available gratis on request.

Streamlined Turbine Blowers for High Pressures and High Temperatures

L. J. Wing Mfg. Co., 156 Vreeland Mill Road, Linden, N. J. announces a line of turbine blowers with Wing all-steel turbines, suitable for steam conditions up to 600 PSIG and 750° total temperature.

While retaining the basic advantages of compactness and light weight, rugged and dependable design, ability to be installed in most any location, and low initial and installation cost, these blowers have been modernized with fan impellers of true airfoil design and streamlined air entry, for high efficiency, and quiet operation. No water cooling required since bearings and lubrication system are automatically air cooled.

For oil burner applications they can be bolted directly to the front windbox without additional supports. Also can be furnished for vertical down discharge, or for cementing into boiler brick work. They are ideal for capacity regulation through speed variation. Can also be furnished with voltrol vanes and constant speed governors for damper regulation. Capacities to 70,000 CFM or statics to 20" H_2O.

Easier Molding and Improved Properties With New G-E Silicone Rubber

Pittsfield, Mass.—A new silicone rubber compound developed by the Chemical Department of the General Electric Co. now permits rubber fabricators to mold silicone rubber parts easier and with highly improved mechanical and thermal properties.

Designated as 81223 compound, this new G-E silicone rubber is outstanding for its ease in processing. Many parts can be fabricated from it without prolonged oven cure and it has excellent molding and extrusion properties after only a five-minute warm-up. Because of the outstanding hot tear strength of G-E 81223 silicone rubber, parts with undercuts can easily be removed from molds; and being neutral in color stock can be colored for product identification purposes for individual fabricators.

Fabricated parts obtained with General Electric's new silicone rubber compound have high tensile strength, high elongation, excellent electrical properties, and are serviceable over a wide temperature range (550°F to −85°F).

Many new applications for silicone rubber mechanical goods, including diaphragms, boots, sleeves, belting, hose, and mountings, are anticipated as a result of the improved molding characteristics and improved properties of General Electric's new compound.

New Hilliard Slip Clutch

A new slip clutch has been designed by the Hilliard Corp., 149 West Fourth St., Elmira, N. Y., to help solve the problem of maintaining constant tension or constant torque on winding operations. The new clutch has wide application in industrial winding uses such as the printing, paper making, plastics, wire and textile industries. This new slip clutch is designed for use also as a safety device for overload protection or to maintain constant torque regardless of driving speed.

Special features include ventilated plates, cooling fins and pressure springs with long deflection range for accurate adjustment. Single, double and triple plate construction is available. When the function is constant tension, the regular adjusting nut is replaced with a sliding collar to permit adjustment while the unit is in operation.

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Some models are constructed with a disc spring and metallic friction plates in a compact design to fit small space. High grade iron or aluminum castings and steel is used for the parts and exposed surfaces can be cadmium plated for corrosion resistance, where necessary.

The clutches are offered in sizes from $2\ ^{3}/_{4}$" diameter to 27" diameter with torque range up to 10,000 foot pounds and heat capacity up to $8^{1}/_{2}$ horsepower.

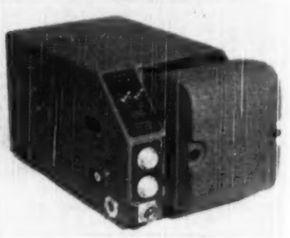
Hallowell Cabinet Bench

Standard Pressed Steel Co., Jenkintown, Pa., announces the newly improved Cabinet Bench as a part of their popular "Hallowell" Shop Equipment Line. SPS Co. designed the "Hallowell" Cabinet Bench for men accustomed to the finest tools and equipment, giving it more "custom" features than any other stock bench they know of. All-steel construction, choice of top materials, ample storage space, standardized units, interchangeable accessories, and trim good looks are just a few of its advantages. "Hallowell" Bulletin #702 tells the complete story.

Consolidated Manufactures Small, Low-Cost Oscillograph

The latest addition to Consolidated Engineering Corporation's line of precision dynamic measurement and recording instruments is the new Type 5-116 Recording Oscillograph. This new design is aimed at low-cost, high-volume production. The new oscillograph sacrifices nothing in quality or performance, but is offered at a price so low that no adequate comparison can be made between it and existing oscillographs.

In physical appearance, the 5-116 is similar to the larger oscillographs manufactured by Consolidated. However, its over-all dimensions have been appreciably reduced, and its weight cut by a factor of almost 50 per cent. Thus, it combines low price and high quality with compact rugged construction and reduced weight.



Basically, the instrument is comprised of two main castings, a webbed-base casting upon which are mounted all of the major components (with the exception of the optical system), and a front casting which houses the operational controls and the critical components of the permanently fixed optical system. Attached to this front casting, but easily and quickly removable, is the combination feed and takeup magazine which has a capacity of 125 feet of 5-inch-wide recording material.

The magazine is made up of two castings: the main housing, and coverplate. Such construction assures extreme rigidity and eliminates any possibility of misalignment from accidental rough handling.

Recently, Consolidated adopted a new record transport system to be incorporated in their standard 5-114 and 5-115 Recording

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Oscillographs. This new system is also a part of the 5-116. Through a unique design, neither sprocket teeth nor a pressure roller is required to provide positive record engagement, thus removing the major sources of record-drive malfunction, and at the same time reducing the power required to drive the recording medium.

With these new improvements, it is now possible to drive the record well in excess of 100 inches per second and accurately maintain control. For the first time in a low-cost instrument, there are provided sufficiently high record speeds to make possible the recording of transient phenomena in minute detail.

In order to utilize most conveniently the wide range of record speeds from $^1/_4$ to 100 inches per second, a quick-change, ten-speed transmission is available in the new instrument as an optional feature. The standard transmission makes use of change gears.

Source of power for the record transport system is an exceptionally powerful governor-controlled motor directly connected through gearing to the record drive roll in the magazine. Thus all belts, friction drives, etc., are eliminated so that the full power from the motor may be utilized in obtaining maximum record acceleration without slippage, and to assure accurate speed control during the recording period.

Record tension is maintained constant throughout the entire 125-foot length of record by an ingeniously designed "controlled torque" clutch, thus assuring the utmost in smooth operation.

Another innovation incorporated in the 5-116 is Consolidated's exclusive "Combed Light" double-collimating optical system, which provides for the projection of high-intensity light in controlled beams onto the galvanometers, thus eliminating all objectionable stray light. The result is a record exhibiting exceptionally fine traces with high definition.

A new prefocused galvanometer lamp (designed to CEC specifications) provides a highly efficient source of light for the galvanometers and is a contributing factor in obtaining the high-quality records characteristic of the instrument. Using this source, the 5-116 is capable of writing speeds of approximately 25,000 inches per second on Eastman Linagraph 1127.

The 5-116 Oscillograph is designed to use CEC Series 7-200 Galvanometers, which have made the 5-114 and 5-115 Oscillographs famous since their introduction three years ago. These galvanometers are available in a wide variety of sensitivities and frequency ranges, thus providing the instrument with extreme flexibility in its applications.

One interesting sidelight in the design of the 5-116 is the departure from standard practice in the record-numbering system, where normally two counters are operated in step, one for recording the record number and the other for visual indication of the same number. In the 5-116, one of these counters has been eliminated, and means is provided for both viewing and recording the same counter. Thus it is impossible for the system to get "out of step."

Despite the instrument's small size and compact design, all components are readily accessible for adjustment or replacement. The cover, which may be removed by loosening two small fasteners, exposes the top, both sides, and the rear of the instrument. The galvanometer and timing lamps may be replaced without removing the cover or side panels, the design providing for access to them at the right side of the front casting. Similarly, the record-numbering lamps are accessible on the left side of the instrument after the cover has been removed.

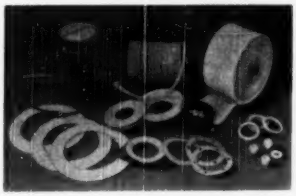
All galvanometer connections are provided at the rear of the instrument and consist of individual self-locking 3-pin Cannon connectors, which have been adopted as standard for this purpose on all CEC instruments.

The 5-116 is available in 9- or 14-trace block capacity for either 24–28 volt d-c or 115-volt, 60-cycle a-c drive. Instruments in any of these combinations have the same physical appearance and dimensions.

Consolidated Engineering Corp., 620 No. Lake Ave., Pasadena 4, Calif.

Garlock Packings and Gaskets Made of Teflon

Garlock packings and gasketing materials made of "Teflon" are fabricated in the Garlock factories from a tetrafluoroethylene resin developed by E. I. duPont de Nemours & Co. and marketed by that company under the trade name of "Teflon". They are extremely inert to chemicals, heat resistant, tough and durable; they solve the problem of sealing against acids and chemicals of all kinds.



These Garlock packings and gaskets made of "Teflon" are unaffected by any acid and are highly resistant to all organic solvents and alkalies. They operate at temperatures from below −90° F. up to 500° F. and have high mechanical strength and a low coefficient of friction within that temperature range.

Garlock produces several types of braided and molded "Teflon" packings for use on valves, pump rods or shafts and other equipment. For gasketing flanged joints of all kinds, including glass and porcelain flanges, Garlock envelope gaskets made of a suitable Garlock gasketing material encased in "Teflon" or gaskets made of solid "Teflon" are available in required sizes and shapes.

Babcock & Wilcox Announces Volume Production of Exceptional Refractory Material

Volume production of "Mullite," a tough crystalline compound long recognized as an exceptionally durable refractory material for severe furnace conditions, was announced recently by officials of The Babcock & Wilcox Co., manufacturers of boilers, tubing and refractories. The new material is principally used in the manufacture of B&W "Allmul" firebrick, but will also be available in the form of grain and as a ramming mix.

While furnace engineers have long been aware of the advantages of mullite, high production costs have limited the range of application of the practically all-mullite type of refractory. The significance of "Allmul," according to company officials, is that its economical mass production will open the way to wide-spread application in a great range of industrial furnaces.

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• Keep Informed

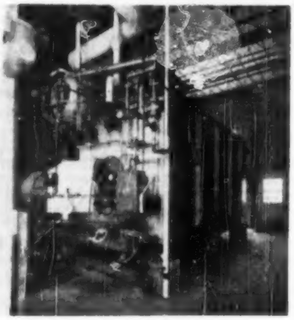
"Furnace maintenance bulks large in the production costs of many industries such as steel, non-ferrous metals, and glass and other ceramics," a company spokesman pointed out. "Allmul," with its exceptional durability and economical first cost, should enable these industries to achieve substantial savings in many of their furnaces by reducing both periodic repairs and lost production time due to shut downs."

The term mullite refers to a chemical composition with the formula $3Al_2O_3.2SiO_2$. Rarely found alone in nature, certain amounts of it are formed when any mixture of alumina and silica are heated to the proper temperature. However, unless a correct proportion of material is used, the mullite crystals are small and widely separated. They are embedded in a matrix of silica which will form a liquid with the mullite at a temperature as low as 2813 F. On the other hand, the ingredients for "Allmul" are so proportioned as to form a high percentage of mullite crystals with no free silica. The small amount of excess material consists mainly of corundum (crystalline alumina) which is also noted for its high refractory properties. The strong, massive structure of the mullite crystals is produced by using an electrically fused grog in conjunction with an unusually high final burning temperature.

Some idea of what this composition and structure mean may be gathered from the properties of "Allmul". Its melting point, for example, is 3335 F. (Ordinary steel melts in the range of 2370–2550 F.) Its cold crushing strength is 1.7 tons per square inch and under temperature, it shows practically no deformation when saturated with heat at 3050 F and loaded for 1½ hours at 25 psi. It also possesses remarkable resistance to thermal shock (spalling). When heated to 3000 F for 24 hours and then alternately heated to 2550 F and chilled in an air-water blast for 12 cycles, "Allmul" shows no sign of spalling loss. Bulletin R-29, describing "Allmul" in detail, is available on request.

"Allmul" is being manufactured in a new addition to the B&W Refractories Division plant at Augusta, Ga.

Foster Wheeler Package Steam Boiler



Foster Wheeler Corp., 165 Broadway, New York, N. Y., announces that one of its package steam generators has been installed at an eastern bulk storage plant of a major refinery. This installation represents another use for the package steam generator which Foster Wheeler has been making in various sizes since 1940.

• Keep Informed

In connection with this new installation, Foster Wheeler reports that the steam generated by this water tube boiler is used primarily to heat heavy oils to a viscosity suitable for pumping and transporting. The unit also furnishes steam for heating the refinery office.

Available in capacities ranging from 3,000 to 30,000 lb of steam per hr., Foster Wheeler package steam generators provide heating surfaces of from 606 to 3,675 square feet. They can be supplied in any of the following pressure groups—100 to 300 psi; 450 or 850 psi. All units have fully automatic controls and are adaptable to any steam requirement. They are also designed for the installation of superheaters.

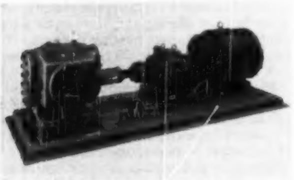
To date these package generators have been ordered for use in the following industries: food processing, electrical manufacturing, dyeing and finishing, paper making; steel manufacturing, electric conduit plants, soap making, general manufacturing, oil processing and now, bulk oil storage.

Another feature of the package steam generator is the ease with which it can be shipped by any type of common carrier, such as trailer, flat car, barge, or cargo vessel. These units are ready for immediate operation after service connections have been made.

These package steam generators may be fired by oil or gas or a combination of these fuels.

Steam Jacketed Pump for Handling Viscous Liquids

A new Steam Jacketed Herringbone Gear Pump for handling viscous liquids such as hot road oils at high temperatures is being offered by Schutte & Koerting Co., Philadelphia, Pa.



To insure even thermal distribution, the steam jacket on these pumps completely covers the internal parts. The inlet, outlet and cover flanges are cast integral with the pump base, and rigid housing construction eliminates any possibility of distortion due to pipe line strain or misalignment. Straight bore housing also prevents shaft deflection and bearing overhang. Shafts are of heavy duty alloy steel, finish ground.

Pressure on the stuffing box is dissipated through a channel in the cover plates. Steam connections on the pump jackets are readily accessible and are designed to permit a variety of piping arrangements. The complete rotor and bearing assembly can be removed as a unit simply by releasing the coupling and removing the rear cover.

All gears are case-hardened, press-fitted and keyed to the shaft to prevent lateral or radial movement. To prevent slippage, the gear teeth have a specially designed high pressure angle tooth.

SK Steam Jacketed Herringbone Gear Pumps are available in Meehanite B, cast steel, bronze or special alloy case. Internal parts are built to specifications.

For further information on these pumps, write to Schutte & Koerting Co., Dept. P-A, 1166 Thompson Street, Philadelphia 22, Pa.

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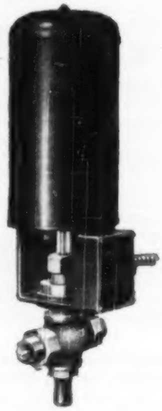
Sarcostat Hydraulic Motor Valve

Sarco Co. Inc., Empire State Bldg., New York, N. Y., announces the introduction of a new electro-hydraulic motor valve for open-and-shut control. Two-wire, normally closed, for direct connection to 110 Volts A.C., 60 cycle current.

This valve is designed for automatic operation by thermostats or pressurstats or by liquid level or flow controls.



As a shut-off valve in an inaccessible location, it can also be actuated by a push-button. The Sarcostat valve is constructed to handle steam, water, oil, gas, air, etc. This is also an ideal valve for the remote control, by hand or thermostat, of steam or water branch mains for space heating systems. Its gradual opening action protects the piping. Quick closing prevents overheating.

The valve operator, actuated by hydraulic power, operates single seated valves up to $1^1/_2$" or double seated valves up to 4" at 125 psi. It does this by direct thrust—without resort to pilots, gears or levers.

When the full stroke is used, standard valves will open in 60 seconds and close in 10 seconds. Also available with an adjustable stop for partial throttling.

Valve bodies are of brass or iron with union or flanged connections. Various types of valve bodies are available: single seated, needle, piston or double seated.

Operators are dust-moisture and fume-proof. They also can be furnished explosion proof.

Ask for bulletin #1080-A which is printed in two colors and contains cross-sectional drawings, capacity charts, prices and detailed information.

G-E Rubber-Phenolic Plastics

Pittsfield, Mass.—A special impact test, designed to reflect the unusual resilience of G-E rubber-phenolic plastics to repeated shock, has been announced by Wyman Goss, engineer of phenolic products for the Chemicals Division of General Electric's Chemical Department.

Standard Izod or Charpy impact tests do not give a true indication of the resilience of G.E.'s new rubber-phenolic compounds, Mr. Goss stated. A "drop-ball" test was selected because by careful selection of the height from which the ball was dropped and the weight of the ball dropped on a molded part, repeated shock could be applied to the test specimen at a range of points up to its actual breaking point.

Keep Informed

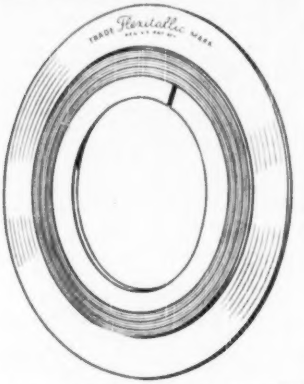
Results of the "drop ball" test which are calculated in foot pounds of energy to crack or break the specimen, show that G-E rubber-phenolic compounds have shock resistance five to ten times as great as equivalent conventional phenolic molding powders.

The outstanding shock resistance of G-E rubber-phenolic molding powders has permitted plastics applications which heretofore have been considered impossible.

A New Gasket

A new high-pressure gasket streamlines jointed connections, reduces turbulence in the piping and increases flow of fluid.

Flexitallic Gasket Co., Camden, N. J., reports that this new gasket (Style CGI) is a compression gauge type with both an inside and outside ring. It has a spiral-wound construction with alternating V-crimped plies of metal and filler.



In every pipe there is a certain amount of skin friction which sets up little eddies in the fluid passing through. At the joint, this friction is increased as the fluid pushes into the recess between flanges. With the new Flexitallic Gasket, the steel ring practically fills the flange recess so that no turbulent barrier is set up. Flow is increased.

For all practical purposes, the inside ring converts one of a pair of smooth face flanges to a groove flange, providing all the safety of a wholly contained gasket without the expense of machining a flange.

The inside ring also provides a compression gauge which supplements the outside ring. It prevents radial movement of the gasket under extremely high bolt loads and minimizes gasket contamination from highly corrosive fluids.

The new Style CGI Gasket is made for practically all standard A.S.A. and A.P.I. fittings as well as special designs. Pressure range is 150 to 2500 lbs. In addition to stainless steels, the inside ring can be made with other premium metals such as monel, nickel or inconel. Ring thickness depends on flange face finish, as well as the yield factors of the gasket proper.

The gasket is designed so that the inside ring can be conveniently remounted in new replacement gaskets as an economy measure. The inside ring is also being used with the self-centering type of gaskets (Style D), made by Flexitallic for raised face, smooth face, vanstone and lapped joints, as well as with the Flexitallic Style R-1 Gasket for large male and female joints.

A wide choice of metals and filler materials are available, including teflon.

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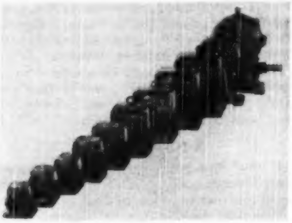
Heavy Duty Model Reductors



Boston Gear Works, 66 Hayward St., Quincy 71, Mass., announces the addition of new, improved, heavy duty model Reductors to their already extensive stock line of Speed Reducers. The very complete range of T Series, Horizontal Right Angle Drive Reductors, pictured, is representative of these heavy duty units which are equipped with heavy Boston gears, worm integral with shaft, housings of Boston Gear ion and rugged steel shafts.

An improved numbering system makes it easy to select the correct Boston Reductor for any speed reduction requirement. There are eight types, each in a range of speed ratios and horsepowers or load carrying capacities. Gear ratios run from 1 to 1 up to 4000 to 1. Output speeds, based on full load motor speeds, run from .45 to 588.23 R.P.M. The new Heavy Duty Boston Reductors are available from stock at eighty Boston Gear Distributors throughout North America.

The new Boston Gear Catalog No. 55 contains ready reference charts for quick selection of the right Reductor for each and every purpose. Copy of the Catalog may be obtained by writing Boston Gear Works.

G-E ACA Motor Now Available with Preset Speed Device

The General Electric ACA motor (a-c adjustable-speed) is now available with a mechanical follow-up control for achieving a fixed preset speed without the use of expensive control equipment, it was announced recently by the G-E Small and Medium Motor Divisions.

According to the company's engineers, the new device enables a predetermined speed to be set manually by a knob either directly on the ACA motor or at the end of a flexible cable 10 or 15 ft away. The speed adjustment can be made while the motor is at a standstill or while it is running.

• Keep Informed

Speed control of the ACA motor, the engineers explained, is obtained by rotating brushes around the commutator. Since speed is a function of brush position, any device that will automatically bring the brushes to an adjustable predetermined position on successive starts will serve the desired purpose of establishing preset speed operation. This is now compactly and conveniently provided in the preset speed device, they said.

In operation, the new mechanism actuates a pilot motor which drives the brushes to a position corresponding to the setting of the speed adjustment knob. A stop or automatic slow-down returns the brushes to the lowest speed position without disturbing the original setting. When the ACA motor is restarted, the brushes again come back to the preselected speed without any attention from the operator. Accelerating time is dependent upon pilot motor speed.

According to G-E engineers, preset speed operation is an advantage in practically any adjustable-speed drive. Some of the applications for the ACA motor with the new device are on offset printing presses, can-sealing machines, planer-feed-roll drives, conveyor drives, ball mills, small rolling mills, mixers, punch presses, fan drives, and others.

SKF to Equip 51 Brazilian Cars

Philadelphia—SKF Industries, Inc., announces that it will equip with spherical roller bearing journal units 51 cars on order here for the Sorocabana Railroad in Brazil.

The passenger cars, all of lightweight stainless steel, will be built by The Budd Co., the first such order to be placed by a Brazilian railroad in this country since 1947. They include 15 first class, 15 second class, six baggage, 10 bedroom sleepers, and five kitchen-dining cars.

A total of 408 sets of spherical bearings will be required. The Sorocabana Railroad operates in the state of Sao Paulo.

Westinghouse Synchro Glide

A new development by engineers of the Westinghouse Elevator Division, Jersey City, N. J., softens an elevator's landing so much that most passengers don't know when the car has stopped, reported W. O. Lippman, vice president in charge of the division.

In addition to making an elevator's landing so smooth, the newly developed Synchro-Glide Landing system saves a second and a half on each floor-to-floor trip, Mr. Lippman said. This time saving increases the passenger-handling capacity of a car up to 10 per cent.

Trips are faster because Synchro-Glide permits cars to delay slowing down for a stop until they arrive much closer to the floor than do other automatic landing systems. Now, a car can arrive at a point 20 inches from the floor while traveling at 250 feet per minute—an approach speed faster than ever before possible. As a car reaches this point, the landing system is set into operation automatically. A series of magnets, called inductors and mounted vertically on top of each elevator car, are energized. Each of these inductors in turn, as it comes closer to the floor, signals an accurate speed control to smoothly reduce the car's motor speed until it is stopped. Speed is reduced according to a predetermined pattern, so the slowdown is gradual and smooth.

Because the speed of the elevator is so closely regulated even during the final 20-inch landing pattern, a car equipped with the new system makes perfect pin-point landings every time. The car never overruns the floor, thus saving the time other

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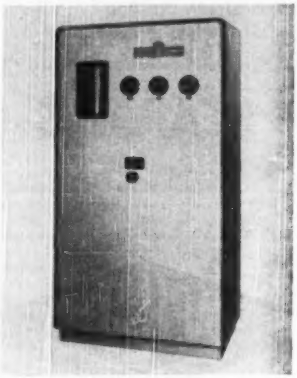
systems need for releveling. Door opening is completely synchronized with the car's slowdown, thereby enabling passengers to enter and leave the cars more quickly, and helping to reduce over-all trip times. The system also saves power and reduces wear and tear on the elevator equipment.

Builders Announces High Capacity Chlorinizer

Builders-Providence, Inc., Providence, R. I., announced and introduced the new HCVS High Capacity Chlorinizer at the National Exposition of Power and Mechanical Engineering held at Grand Central Palace, New York City, Nov. 27–Dec. 2, 1950. This Chlorinizer has the visible gas flow feature which is standard on the line of equipment. In addition to the visible flow feature, the new Chlorinizer has automatic control to provide chlorine to three points of application.



This automatic control will provide the proper feed rate to meet the chlorine demand at three individual points and also will select the sequence of point of application. The HCVS high capacity visible flow Chlorinizer insures that chlorine dosage at any point of application will be properly controlled and metered for any pre-determined period at a suitable pre-selected rate to meet the chlorine demand at that point.

The HCVS high capacity visible flow Chlorinizer is a new simplified apparatus for metering and controlling chlorine gas feed by manual, semi-automatic, or automatic proportional means. It will find use in the power industry for the control of slimes in cooling water systems, in chemical processing industries, and for the disinfection of water for domestic and industrial water supplies as well as in industrial waste treatment.

Further information on this new unit may be obtained from Builders-Providence, Inc., 345 Harris Avenue, Providence 1, R. I.

Westinghouse Producing Radiation Detection Meters

A radioactivity-measuring instrument, the Universal Roentgen Meter, is now being produced by Westinghouse Electric Corp.

The meter is the measuring part of radiation detection devices which reveals radiation, expressed in milliroentgens, that the device detects, thus indicating the amount of radioactivity present in any area. A roentgen is the basic measuring unit of alpha, gamma, and beta rays, which may be produced by an x-ray machine, a piece of radium, or an atomic bomb explosion.

• Keep Informed

The Universal Roentgen Meter is equipped with multiple scales, either four, five or six, which make possible fine readings in all ranges of radiation. The four scale model covers four ranges of radiation: zero to half a milliroentgen; zero to five milliroentgens; zero to 50 milliroentgens; and zero to 500 milliroentgens.

Setting a switch determines which of the multiple scales will operate and will be visible, thus eliminating incorrect reading by use of the wrong scale.

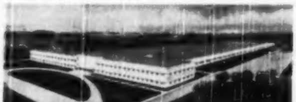
The instrument is sensitive enough for use in x-ray work, but also accurately measures large amounts of radiation encountered in atomic fission research.

For further information write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pennsylvania.

• BUSINESS CHANGES

Powers Regulator Co. Erecting New General Office and Factory Building

Scheduled for completion next summer at the time of the company's 60th anniversary is the new Powers' plant on its 13 acre site in Skokie, Ill.



Sessions Engineering Co. of Chicago are the architects and engineers for the building which will contain 130,000 square feet.

The new building is 575 feet long. The two-story office, test and research laboratory section which is 290 feet wide is to be constructed of face brick and stone and will be completely air conditioned.

Products to be manufactured in this new modern plant include the company's extensive line of automatic temperature and humidity controls for heating, air conditioning and industrial processes; thermostatic controls for water heaters, shower baths and hospital hydrotherapy.

SKF to Expand Production of Balls, Rollers

Philadelphia—SKF Industries, Inc., in a move to keep pace with increased demands of major industries for anti-friction bearings, announces it will expand productive facilities at its ball and roller plant here.

John Lawrence, vice president, said a new addition, providing more than 40,000 square feet of floor space, will enable the company to forestall critical bottlenecks in the manufacture of rolling elements for aircraft and Diesel traction motors, of which it is one of the nation's major manufacturers.

Construction of the addition is expected to be started in three or four weeks. Five to six months will be required for completion, but delivery of new equipment is expected to delay full use of the new facilities until the middle of 1951.

The added space, Lawrence said, will permit a larger output of rollers for cylindrical bearings as well as a higher quality of rolling elements for ball bearings. New means developed by SKF to finish balls to extremely fine tolerances and exacting geometry now

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require longer cycle times and therefore more machines to produce in quantity, he explained.

At the same time, Lawrence disclosed that a substantial part of the company's operations in its Philadelphia plants are on a 48-hour week to fill production schedules which, he added, "have had to be revised sharply upward in the last three months." Some departments are operating three shifts seven days a week.

"Despite the accelerated rate of incoming orders, and the likelihood of military priorities, we are far better prepared to face the heavy demands that may be made than at the start of World War II," he declared. "The company has spent many millions of dollars for expansion and modernization since the end of the war."

Factory payrolls of the company have increased about 20 per cent in the past year. Employees in the Philadelphia plants now total approximately 3,500.

T. E. Skilling Named Edward District Manager in Pittsburgh Area

East Chicago, Ind.,—Thomas E. Skilling has been appointed Pittsburgh district sales engineer for Edward Valves, Inc. As Edward representative in the area, he succeeds the Herr-Harris Co.

Mr. Skilling, who has been associated with the Herr-Harris Co. for several months, will continue his office at 545 William Penn Place, Pittsburgh 19, Pa. The phone number, GRant 1-6475, is unchanged.

A native of Pittsburgh and a graduate mechanical engineer of Lehigh University, Mr. Skilling has been with Edward in home office engineering and sales work since 1947. During World War II he was an engineering officer in the U. S. Merchant Marine. He is a member of the American Society of Mechanical Engineers and the Engineers' Society of Western Pennsylvania.

The Herr-Harris Co. and its principal, Mr. Benjamin M. Herr, have been affiliated with the Edward organization for more than 30 years. Mr. Skilling will continue to work closely with the Herr-Harris Co.

Westinghouse to Expand Little Rock Plant

The Westinghouse Electric Corp. will add a 100,000-square-foot wing to its lamp plant in Little Rock, Arkansas.

According to Ralph C. Stuart, Westinghouse Vice-President, expansion of the Company's westernmost lamp plant would increase its floor space by two-thirds and enable full-capacity operation. There are now 650 persons employed in the plant, which started production two years ago.

"We need all the light bulbs we can produce at Little Rock to satisfy an ever-increasing demand for them in the southwest, southeast, and west," said Mr. Stuart.

"When the addition is completed," he added, "Westinghouse production of household-type light bulbs in Little Rock will rival that in Trenton, N. J., where the Westinghouse plant produces more light bulbs than does any other plant in America."

The construction firm of Ditmars, Dickmann, and Peckens, of Little Rock has been awarded the contract for the design and construction of the addition, which will have a 200-foot front and be 516 feet long. Completion is scheduled for April, 1951.

Incandescent light bulbs ranging from the 15-watt through 300-watt size make up the bulk of Westinghouse production at Little Rock. Sun lamps, heat lamps, and mercury vapor lamps also are manufactured there.

Keep Informed

General Electric Chemical Department Opens Washington, D. C. Office

Pittsfield, Mass.—A new sales office for the General Electric Company's Chemical Department has been opened at Washington, D.C., it was announced by S. L. Brous, marketing manager of the Department. The office will be located in the Shoreham Building at 806 Fifteenth St., N. W.

With increasing defense activities, the Chemical Department has established this office in the capitol area to efficiently serve governmental requirements. Products of the Department include silicones, laminated and molded plastics, electrical insulation, plastics molding compounds, and resins.

Foxboro Company Announces Two Recent Office Openings

Announcement by The Foxboro Co. of two new branch office addresses brings the total of its domestic offices to 39, of which three include branch factory facilities. The Foxboro Co., whose head office is at Foxboro, Mass., is one of the leading manufacturers of industrial instruments for measurement and control.

The newest addition to the list is the branch office at 214 W. 10th Street, Wilmington 1, Del., under the managership of Kenneth L. Barton, a 25-year man with The Foxboro Co., well acquainted in industrial circles in the New York area and along the Atlantic Coast.

Earlier this year a Foxboro Co. office was opened at 225 S. 5th Street, Minneapolis 2, Minn., with Robert C. Cahill as Resident Engineer. Foxboro interests have been represented in the Minneapolis-St. Paul area for many years by a well known firm of engineers; but the mounting volume of business prompted the opening of a full-scale branch office and the transfer of Mr. Cahill from the Foxboro branch at Appleton, Wis.

American Felt Co. Recognition Award

Recognition that it had come of business age—50 years old in Connecticut—has been received by The American Felt Co. of Glenville, Conn., the world's largest producer of wool felt, in the form of an award by the Manufacturers Association of Connecticut.

The award was made to John T. Lawless, president of the company, which was founded at Glenville, February 8, 1899, and which today has grown up to include manufacturing plants in Glenville, Newburg, N. Y.; Franklin, Mass.; Westerly, R. I.; and Detroit, Mich. It was accepted by W. H. Lehmberg, an American Felt vice president.

Some 304 Connecticut companies, 50 years old or more, were given the recognition awards by the Manufacturers Association during its annual meeting at Yale University New Haven, Conn., September 12.

Chiksan Headquarters in Rocky Mountain Area

Chiksan Co., Brea, Calif., has established sales headquarters for the Rocky Mountain area in Salt Lake City, with B. P. Ragsdale in charge. With a wealth of experience gained as a member of Chiksan's Engineering Department, service representative and sales engineer in the Southern California territory, Mr. Ragsdale will handle sales and service on Chiksan, "Weco", Anchor and Okadee products.

Chiksan's Rocky Mountain headquarters were formerly in Denver, with Al Myers as sales representative. Mr. Myers has resigned to enter business for himself.

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Murray Equipment Co. Takes on Worthington Multi-V Drives

James J. Murray, owner of the Murray Equipment Co., 11820 Brush Street, Detroit, announces a recently signed distributorship agreement to handle Worthington Pump & Machinery Corp. Multi-V Drives and fractional horsepower belts and sheaves.

The Murray Equipment Co. has supplied the greater Detroit area with chains, sprockets, tubing, hose and pulleys since 1946. Its staff, experienced in the power transmission field, includes: William Anderson, Sales Manager; William Faulk and Joseph Livermore, Sales Engineers; and Charles Macbeth, Office Manager.

Howell Electric Motors Service Representatives

Howell Electric Motors Co., Howell, Michigan, announced the appointment of Bates Sales Co., 1025 North Sixth Street, St. Louis 1, Missouri, as Factory Sales and Service Representatives in the St. Louis area for Howell electric motors.

The Bates Sales Co., under the able direction of Mr. Howard D. Hebebrand, owner, has won a wide reputation for exceptional service to business and industry in the St. Louis area.

• LATEST CATALOGS

Morse Factory-Packaged Chains

Folder F 57-50 gives a complete description of all Morse Factory-Packaged chains and parts together with list prices. This is the first complete packaging program in the industry. Morse Chain Co., 7601 Central Avenue, Detroit 8, Michigan.

New Publication on Water Clarification

Cochrane Corp., 3142 No. 17th St., Philadelphia, Pa. has just published a bulletin describing the Cochrane Liquon Sludge Contact Reactor, (Publication #5001), a water conditioning apparatus that takes advantage of the well-known chemical principle that previously formed precipitates added in the form of sludge or slurry will accelerate reactions. The bulletin details the principle as applied to the sludge-contact reactor, describes the operation of the Cochrane-Liquon unit, illustrates and describes the types of equipment available, gives a list of applications with a separate page on waste recovery and describes the auxiliary equipment. Photos of typical installations are also shown.

G. E. Offers Motor-Generator Booklet

A new eight-page, two-color booklet on synchronous motor-generator sets has been announced as available from the General Electric Co., Schenectady 5, N. Y.

Designated as GEA-5506, the publication covers motor-generator sets from 30 to 8000 kw as a source of d-c power for many industrial applications, such as rolling-mill motors and other drives, electrolytic refining of ores, excitation for synchronous and d-c motors and generators, motion picture lighting, mining and quarrying, wind tunnels and other large testing equipments, and general purpose use.

Well illustrated, the booklet shows four typical installations and describes the construction features of the synchronous motors and d-c generators. Motor ratings include 60, 50, and 25 cycles, 0.8 pf, 220 to 13,200 volts. Generators, both shunt and compound wound, are rated 125, 250, and 600 volts.

• Keep Informed

Allis-Chalmers Motor Starters Bulletin

Allis-Chalmers motor starters—Type H—for 2300 to 5000-volt squirrel cage, wound rotor, synchronous and multispeed motors are described in a new 12-page bulletin released by the company.

The starters are built for full voltage or reduced voltage, reversing or non-reversing, with plugging, dynamic braking and multi-speed features. Ratings are up to 2500 hp at 5000 volts. The contactors (air break or oil immersed), protective devices, meters, and relays are engineered and assembled in an easy to install steel cabinet.

The air break contactor—Type 256—particularly adaptable for applications requiring frequent starting, inching, reversing, plugging or dynamic braking is described in detail in another late bulletin. For most applications, this contactor will fit in the same size starter cubicle as used for oil immersed contactors.

The oil immersed contactor—Type MO—is designed to withstand stresses of frequent starting and stopping service and can be used in dust laden atmospheres and in other locations where atmospheric contamination would interfere with the proper operation of air contactors.

Dependable start-stop service and control of motors is provided by Allis-Chalmers air break or oil immersed contactors in power and cement plants, rubber and paper mills, refineries, pumping stations, pipe lines and general industrial plants. They have been applied for the control of pumps, blowers, compressors, motor-generator sets and other industrial drives.

Copies of the bulletins, "Type H Motor Starters," 14B6410A, and "Type 256 High Voltage Air Break Contactor," 14B7303, are available upon request from Allis-Chalmers Manufacturing Co., 949 S. 70th Street, Milwaukee, Wisconsin.

New Condensed Catalog Issued By Clark Equipment

A condensed catalog containing basic specifications of its entire line of materials handling equipment is announced by the Industrial Truck Division of Clark Equipment Co. Models listed include fork-lift trucks, both gas-powered and electrics, on solid tires and pneumatic tires; industrial towing tractors; tructractor models for handling bulk materials; and the complete line of twenty special attachments designed for particular needs.

Fork truck specifications cover capacity, turning radius, load center, minimum intersecting aisle, truck dimensions, fork length, upright heights (low to high), fork lift heights (low to high) and service weight. Tractor specifications include drawbar pull, capacity in tons, turning radius, overall dimensions, tire sizes and weight. Tructractor specifications give capacities in cubic feet and pounds, turning radius, overall dimensions, body dimensions and weight.

Special attachments listed are the overhead guard, load safety rack, ram, crane, fork extensions, shovel, Hi-Lo-Stack, 360° rotating device, rotating roll clamp, upender, side shifter, cotton clamp, Clamp-Lift, heavy duty clamp, swinging boom, Bartel device, brick forks, cabs, snow plows and pitch-fork shovel.

The catalog has eight pages printed in two colors. The back page contains a directory of U. S. and Canadian dealers.

A copy of the catalog is obtainable on request to Clark Equipment Co., Industrial Truck Division, Battle Creek, Michigan.

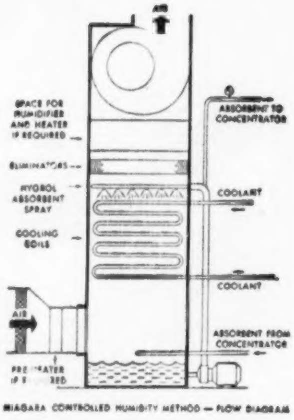
Continued on Page 56

How You Save with the NEW Niagara Method of Air Conditioning

Using "Hygrol" Absorbent Liquid

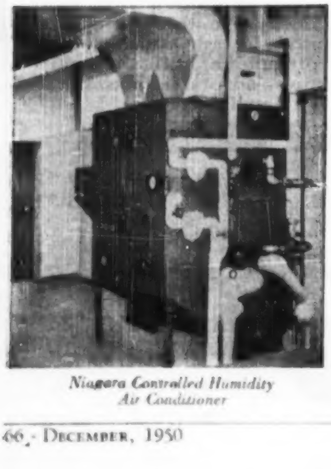
Because it absorbs moisture from the air directly, the new Niagara Controlled Humidity Method uses less, or no, mechanical refrigeration for dehumidifying. You save first costs and installing of heavy machinery. You save space, maintenance expense, power. You get easier, more convenient operation.

Using "Hygrol" hygienic absorbent liquid, this method gives complete control of temperature and relative humidity. Especially, it is a better way to obtain dry air for drying processes, packaging hygroscopic materials, preventing moisture damage to metals, and obtaining better quality for chemical process products and food products—or in obtaining better results in comfort air conditioning for office or laboratory at lower refrigeration costs.



NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

Food Packaging under Controlled Humidity



Niagara Controlled Humidity Air Conditioner

The diagram shows how filtered air is dehumidified by passing thru a spray of "Hygrol" —a liquid absorbent which removes air-borne moisture. This liquid is hygienic and non-corrosive; it contains no salts or solids to precipitate and cause maintenance troubles. It is continuously re-concentrated at the same rate at which it absorbs moisture, providing always the full capacity of the air conditioner, automatically.

Units provide a range of capacities from 1000 to 20,000 C. F. M. Multiple unit installations are in use successfully. Records of results are available. For further information, write Niagara Blower Co., Dept. ME 405 Lexington Ave., New York 17, N. Y.

Keep Informed

Electrifugal Pump Bulletin

Design and construction features of a close-coupled pump and motor—the Electrifugal—are described in a new bulletin released by Allis-Chalmers Manufacturing Co.

The Electrifugal has a single shaft mounted in an exclusive unit-cast frame to assure perfect and permanent alignment. The pump is available with drip-proof, splash-proof, totally-enclosed, fan-cooled or explosion-proof motor enclosures. Some sizes can be had with removable casing, others with removable cover plate.

The pumps are available in ratings from 10 to 500 gallons per minute at heads to 220 feet. Motors are rated from $^{3}/_{4}$ to 10 horsepower.

Copies of the bulletin "Electrifugal Pump," 52B6140B, are available upon request from Allis-Chalmers Manufacturing Company, 949 S. 70th St., Milwaukee, Wis.

Index of SK Equipment and Descriptive Bulletins

A new products list folder, entitled "Index of SK Equipment and Descriptive Bulletins" has just been issued by Schutte & Koerting Co.

The folder lists SK products according to application and alphabetically, together with the numbered descriptive bulletin pertaining to each product. Copies of this folder are available. Write to: Schutte & Koerting Co., 1166 Thompson St., Philadelphia 22, Pa.

Electric Motor Lubrication

Interesting studies in bearing lubrication for electrical motors are presented in a new bulletin entitled "Lubriflush," just issued by U. S. Electrical Motors, Inc. It graphically shows comparative amounts of lubricant in different designs of bearings and how bearings are subject to air circulation. Application of U. S. Motors' Lubriflush principle is presented, showing how bearings can be lubricated for life and also can be purged of old lubricant and renewed without disturbing the bearing housing. The Bulletin, No. 1579, may be obtained by writing U. S. Electrical Motors, Inc., 200 E. Slauson Avenue, Los Angeles 54, California.

New Allegheny Ludlum Booklet on Metal in Hospitals

Pittsburgh, Pa.—The past, present and future of stainless steel in the nation's hospitals is the subject of a new booklet just published and released by Allegheny Ludlum Steel Corp.

The eighth in a series of "industry" booklets, "Allegheny Metal in Hospitals" is packed with information and illustrations of the use of stainless steel from basement to sundeck of modern hospitals of today and tomorrow. Particular attention is given utilization of stainless in the hospital service, nursing, and surgical departments, and for adjunct diagnostic and treatment facilities.

A unique feature of the booklet is a check list of more than 800 stainless steel hospital applications, said to be the most comprehensive list ever published.

Before publication, the booklet was checked and approved by a leading hospital authority. It is recommended for those interested in hospital construction, maintenance or operation, as well as for fabricators and others interested in hospital and other medical equipment.

Free copies obtained by writing to Advertising Department, Allegheny Ludlum Steel Corp., 2020 Oliver Building, Pittsburgh 22, Pa.

• Keep Informed . . .

Dual Circulation Steam Generators

Foster Wheeler Corp. points out the advantages of the Dual Circulation Steam Generator over conventional boilers in a copyrighted booklet issued recently entitled, "Dual Circulation Steam Generators for power and process steam of super purity."

Under modern operating conditions of high pressure and temperature, the problem of steam purity is of increasing concern to the designers and operators of industrial and central station steam generators. Foster Wheeler engineers have successfully met this challenge by developing the Dual Circulation Steam Generator.

In May, 1948, the first of a group of Foster Wheeler Dual Circulation Steam Generators was placed in service at a large midwestern refinery. It has been in successful operation ever since and has proved its ability to produce steam of much greater purity than has been hitherto attainable in a boiler of conventional circulation.

Evidence of the increasing acceptance of the Foster Wheeler Dual Circulation Steam Generator is demonstrated by recent additional orders from both the utility and refinery industries.

A Comprehensive pH Electrode Catalog

The complete line of Leeds & Northrup pH electrodes and assemblies for both industrial and laboratory applications is now presented for the first time in a new, 28-page catalog, "pH Electrodes, Assemblies, Parts and Accessories."

This publication is designed to help present users of L&N pH equipment in ordering replacement parts and to guide new or prospective users in selecting the proper electrodes to solve their pH problems.

It lists the advantages of each type of electrode, and by means of an illustrated, double-page spread, shows each assembly and all of its components in tabular form. Glass electrodes for industrial use are shown in detail, whether for use in plastic, Pyrex or iron assemblies; glass electrodes for laboratory use are illustrated with their appropriate measuring instruments. Other L&N laboratory electrodes—hydrogen, quinhydrone, oxidation-reduction—are listed with their reference electrodes.

Accessories and supplies, such as buffer solutions, chemicals, holders and mountings are listed. Also included briefly are the portable and permanently-mounted instruments—L&N indicators, and Micromax and Speedomax recorders and controllers—that are used with these electrodes.

For copy of this publication, write Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa., and ask for Catalog EN-S5.

New Flow Meter Bulletin

A new flow meter bulletin, released by the Republic Flow Meters Co. fully illustrates and explains flow measurement problems and their solution. Meter bodies, differential devices and reading instruments are fully described and a special section is included on wide range and reverse flow. The numerous illustrations in the book relate an informative pictorial story on fluid flow measurement. Write for the Republic Data Book No. 702.

Bulletin on Peerless "Gearturbo" Pump Head

Descriptions of right angle geared pump drives and their application to vertical turbine pumps is the subject of a comprehensive new bulletin issued by Peerless Pump Division, Food Machinery & Chemical Corp. on the Peerless "Gearturbo" pump head.

Right angle gear drive applied to vertical rotative shaft pumps is unexcelled for applications where electricity is not available, where natural gas, gasoline, diesel or steam power is more economical or where the added security of standby power is desired in case of electrical power failure. "Gearturbo" heads are offered in 9 sizes, with speed increasing ratios of 1 to 1, 1 to 2, 2 to 3, 3 to 4 and 4 to 7 and with one speed decreasing ratio of 11 to 10 and in horsepower ratings from 3 to 300 h.p.

The new bulletin describes the construction features of the Peerless right angle gear head and includes complete sectional drawings and dimensions, details of the flexible shafts for connecting driver to the pump head, horsepower ratings of the various size heads and data on combination heads, where electric and right angle gear Peerless pump heads are combined in one unit for stationary engine drive and direct-connected electric power. Suggested methods of installation are shown in station arrangement sketches.

Copies of this new bulletin may be obtained by writing the manufacturer, Peerless Pump Division, Food Machinery & Chemical Corp., 301 West Avenue 26, Los Angeles 31, Calif. and requesting Bulletin B-140-1.

Continued on Page 68

• Keep Informed . . .

Armco "Asbestos Bonded" Pipe

Here's The Drainage Structure With A "One-Two" Punch, a new, illustrated folder by Armco Drainage & Metal Products, Inc., tells how Armco "Asbestos-Bonded" Pipe overcomes the problems of structural failure and corrosion.

More than half a century of experience proves that corrugated pipe has more than ample strength and all other structural features necessary to function as a drainage structure throughout its full material life.

"Asbestos-Bonded" Pipe combines the strength of corrugated metal pipe with positive protection against extreme corrosion that greatly extends its serviceable life.

The folder describes how "Abestos-Bonded" drainage structures are made and summarizes corrosion tests that demonstrate the exceptional durability of the material.

Field inspections confirm that "Asbestos-Bonded" Pipe gives long-time satisfactory service in sewers, culverts and other drainage structures under very severe conditions, varying from salt marshes in New England to jungle swamps in Venezuela.

Copies of this folder, which describes the drainage structure that gives extra protection and eliminates costly replacements, can be obtained from Armco Drainage & Metal Products, Inc., Middletown, Ohio.

New Alco Products Catalog

Alco Products Division of American Locomotive Co. has published a new 16-page catalog containing a fund of useful product information about heat exchangers, evaporators, feedwater heaters, pressure vessels and pipe.

The booklet, for example, shows how the diameter and length of a heat exchanger unit is selected by using the unique Alco "MTD" Calculator and a selector table. Another part of the booklet tells how a helpful template for making piping layouts can be obtained. It is packed full of "how-it-works" information, and design and selection data. There are over 60 cutaway and cross-sectional drawings of heat exchangers, evaporators and feedwater heaters.

In addition to descriptions of the regular shell and tube line of heat exchangers, Alco has included expanded sections on its new industrial exchanger and the Alco Aircooler. A spread on production facilities, and pages of photos showing a variety of Alco installations throughout industry are other features.

For a copy of Catalog AL-3, write on your letterhead to Public Relations Department, American Locomotive Co., Schenectady, N. Y.

New Bulletin on Cone-Drive Speed Reducers

Cone-Drive Gears, Division of Michigan Tool Co., has just released a new, 4-page engineering bulletin. It gives basic general information on standard Cone-Drive speed reducers and gear sets ranging between 5:1 and 70:1 ratio, and from .05 up to 555 hp. capacity. Standardization—for economy and easy service both of component parts and complete units—is emphasized.

The bulletin helps in solving transmission design problems by giving quick-reference data on ratios, center distances and horsepower capacities. Printed in two colors; illustrated with both photos and drawings. Ask for bulletin 789–50.

De Laval New Type GS Pump

Bulletin contains a complete description, cross-section drawing, rating tables and dimension print of our new Type GS pump.

The outstanding feature of the new De Laval GS pump is that it is designed to fit the idea of a Service and Exchange Plan. All parts of the GS pump except the bare pump casing are contained in one easily replaceable rotor assembly. This means that when maintenance does become necessary, you simply remove the top cover and end plate studs, remove the old rotor assembly and drop a new one in place. The old one is then returned for credit on serviceable parts.

Other features of the pump include: Pre-lubricated bearings, Mechanical seals, Stainless steel shaft, Horizontally split cast iron casing, Arrangement for clockwise or counter-clockwise rotation, Interchangeable end covers, shafts, shaft seals and bearings between all sizes of pumps.

The GS pump is built in three sizes from $2^1/_2$" to 4" for capacities to 400 gpm and heads to 230'.

Handling Devices For Textile Industry Described In New Clark Booklet

Clamping devices for use on fork-lift trucks, developed by Clark especially for handling materials in all branches of the textile industry, are described in a new 12-page booklet issued by Clark Equipment Co. A helpful feature is a summary of handling operations now being performed mechanically in modernized mills and warehouses. Address Clark Equipment Co., Industrial Truck Div., Battle Creek, Michigan.

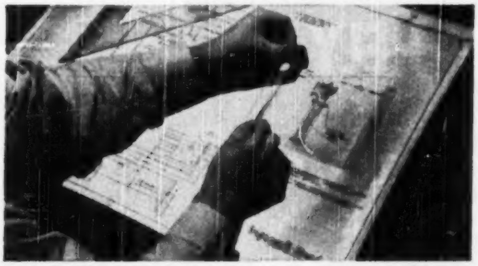
NEW PHOTOGRAPHIC MATERIALS...
NEW DRAFTING SHORT CUTS

Eliminate Costly Retracing

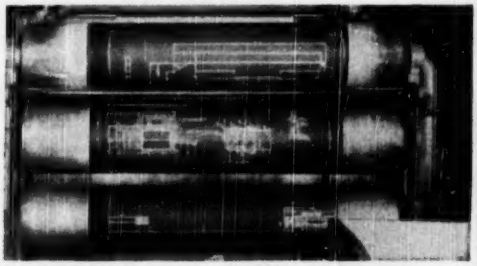
at INGERSOLL-RAND
Phillipsburg, N. J.

"Ink quality" file copies of pencil drawings are produced with Kodagraph Autopositive Cloth
Instead of making expensive "ink on cloth" tracings of its original drawings, Ingersoll-Rand simply reproduces them on Kodagraph Autopositive Cloth. This new photographic material produces positive copies *directly* (like Kodagraph Autopositive Paper and Film) . . . without the negative step . . . without darkroom handling. No special equipment is required, either: a photocopy machine is used for the exposure operation . . . standard photographic solutions for development. *Result:* intermediates that have the sharpness, the sparkle of new ink tracings . . . with non-smudging, dense photographic black lines on a durable white cloth base.

Old, soiled, or damaged drawings are restored with Kodagraph Autopositive Paper
When such drawings are taken from the files, the call is for Kodagraph Autopositive Paper—to eliminate hours of expensive retracing time. This low-cost, high-contrast photographic material increases line density . . . cleans up backgrounds . . . in many cases delivers serviceable intermediates that require no handwork at all. Drawings in very poor condition are restored by Ingersoll-Rand in the following manner: after an "Autopositive" is made, stains, creases, and other unwanted elements are removed with eradicator fluid or razor blade. Then, the print is used to produce a second "Autopositive," which is touched up with pencil if necessary.



Standard units are added to new drawings with Kodagraph Autopositive Film
Among the many ingenious drafting short cuts developed by Ingersoll-Rand is the use of Kodagraph Autopositive Film overlays made from standard-component drawings. These transparencies are kept on file . . . and taped to new drawings whenever necessary. Following this, the composite is reproduced on Autopositive Paper. *Result:* a photographic intermediate of uniform line density . . . plus important savings in drafting time.



Additional advantages of using Kodagraph Autopositive intermediates
Sharper, cleaner blueprints are produced—at uniform, practical speeds—because Ingersoll-Rand makes them from "Autopositives" instead of its perishable original drawings. This way—there's far less chance of "reading errors" in the shop. And valuable originals are protected against machine wear and tear . . . constant handling; are kept safe in the files available for reference and revisions only.

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16

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Kodak
TRADE-MARK

The quiet, vibration-free performance and long gear life you can expect from a Farrel herringbone gear result from extreme accuracy of tooth spacing, contour and helix angle . . . qualities inherent in the Farrel-Sykes method of gear generation.

The herringbone design offers the advantage of a maximum number of gear teeth always in mesh. Overlap or interlacing of the teeth, together with gradual engagement, contribute to smooth operation. Opposed helices balance and absorb axial thrust within the gear member, eliminating harmful thrust loads and resultant stresses on other parts of the machine.

Farrel-Sykes herringbone gears are made of the finest grade materials, in a complete range of sizes, from ¼ inch to 20 feet diameter, ¼ to 60 inch face, 24 DP to 0.75 DP, for any power capacity and any application.

Farrel engineers are available to assist in working out unusual gear problems. Information will be sent on request.

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Plants: Ansonia and Derby, Conn., Buffalo, N. Y. *Sales Offices:* Ansonia, Buffalo, New York, Boston, Pittsburgh, Akron, Cleveland, Cincinnati, Detroit, Chicago, Los Angeles, Tulsa, Houston, New Orleans.

Farrel-Birmingham

FB 622


Walworth manufactures a complete line of Gate, Globe, Angle, Check, and Lubricated Plug Valves, made of Stainless Steel, Steel, Iron, Bronze, and Special Alloys in a wide range of sizes and temperature-pressure ratings.
Fittings of steel, iron, and bronze are also manufactured in all conventional types and sizes.
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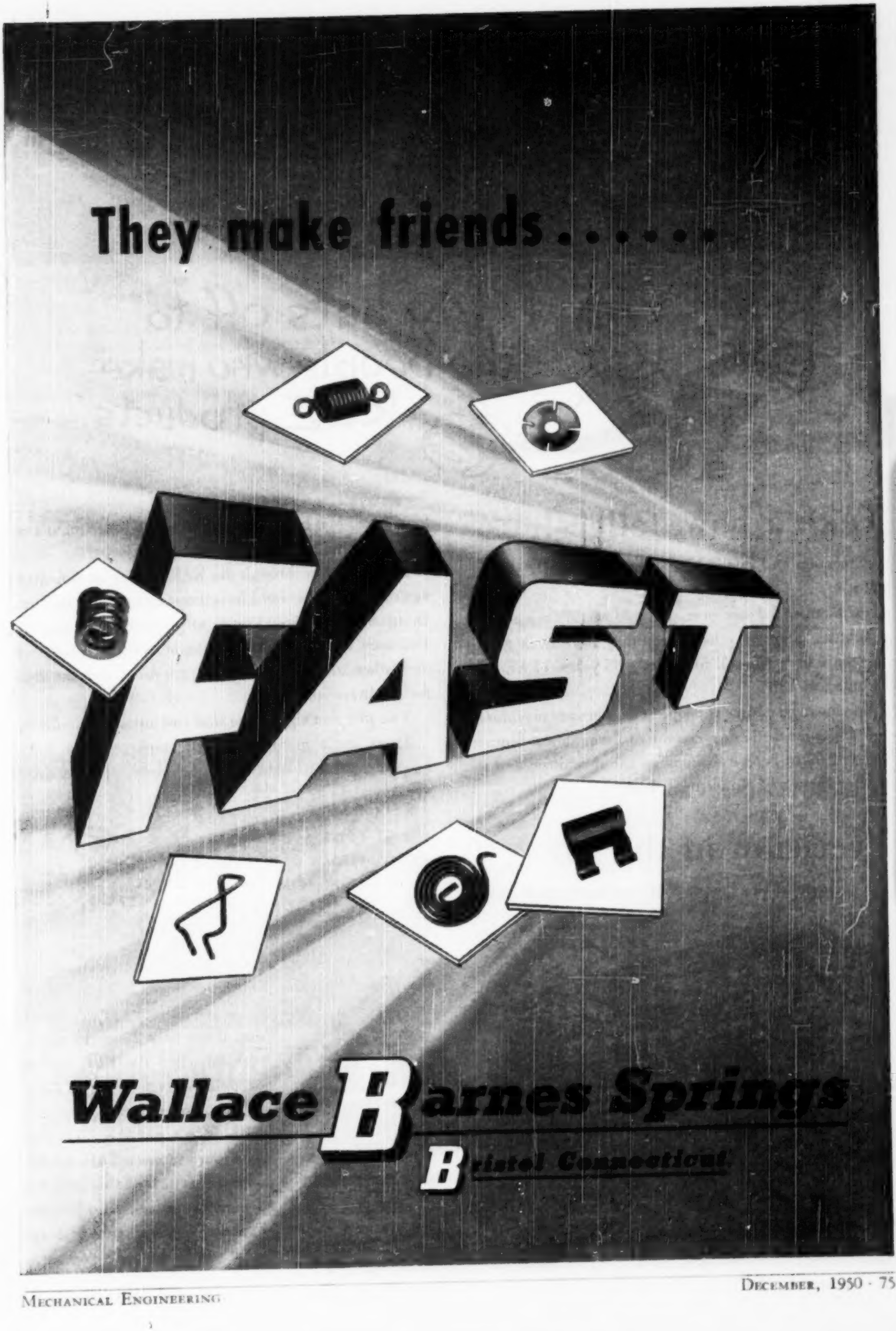
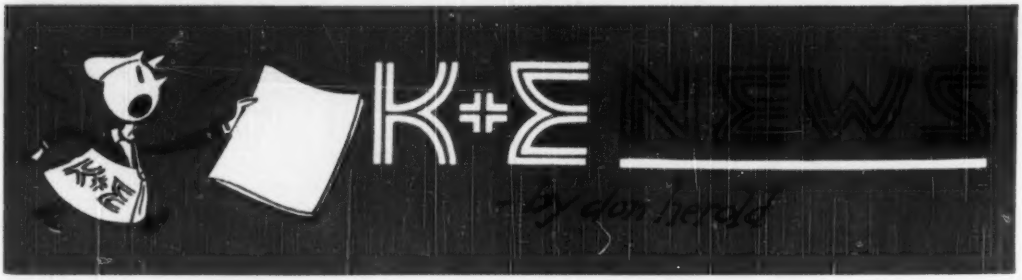

They make friends......
FAST
Wallace Barnes Springs
Bristol Connecticut



My hat's off to the people who make K&E products

Take a bow, fellers!

Precision and quality don't grow on trees. But they grow.

At Keuffel & Esser precision and quality are almost a century plant. In other words they have been growing there in fertile soil for exactly 83 years. (K&E was founded in 1867.)

It's mostly a matter of people. Oh, there are machines, too, big ones, little ones—some of them almost human—but it takes people to imagine the machines, and to master them and supplement them.

Precision in the Air

I've been talking about K&E products for a long, long time. Maybe it's time I talked a little about the people behind them.

I've just been through the K&E factory at Hoboken again. I wish you could have been along, because you, as an engineer, would have seen much more than I. But even I could sense the honest craftsmanship and the father-and-son tradition of precision and the zeal for quality in the air.

You just don't get to be that fine in one generation.

There are a number of K&E employees who have been around for about a half a century, and there are some 150 employees who have been there for a quarter of a century or more. This latter bunch of kids, as well as the young sprouts who have been there only 20 or 15 years, have inherited the K&E feeling for doing things the good, old, exciting, honest way.

But don't get the idea that there is any moss on K&E. An outfit that has thrived this long has to have the knack of remaining perennially young and of keeping ahead of the pack.

MOST K&E WORKERS MUST HAVE CUT THEIR TEETH ON K&E SLIDE RULES

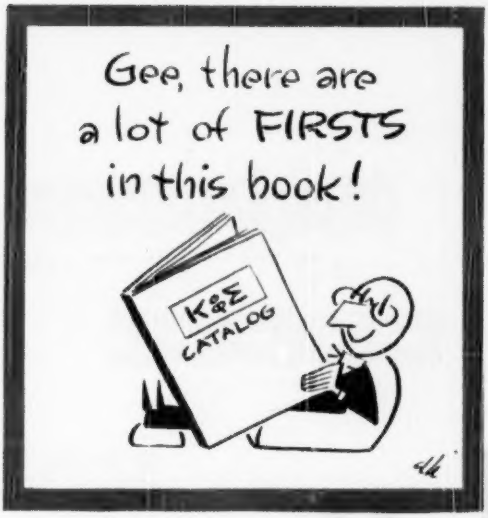
The first factory built by Keuffel & Esser, in 1880.

"Partners in Creating"

When K&E coined the phrase "Partners in Creating," they of course meant not themselves but their products. And it's true that K&E products have been in with engineers, scientists, draftsmen and architects on the creation of most of the big man-built wonders of the world for over 4/5 of a century.

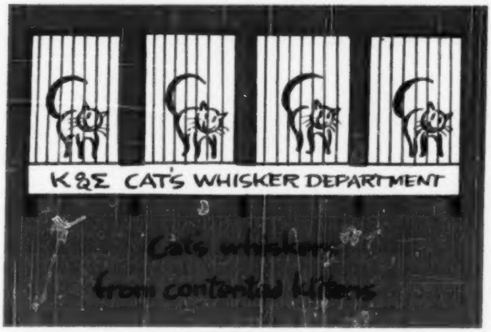
TRADE MARK K+E

The K&E trade mark for decades, and the more modern one ado~ted in recent years.



Zippy at 83

K&E have remained alert and alive, as is evidenced by their unending originality and inventiveness. They made America's first slide rules, as far back as 1891. And in both world wars, they did a big development job on optical equipment for our fighting men—on vital things such as periscopes, fire control instruments and height finders. The K&E catalog is full of "firsts"—some of them plenty recent, such as Wyteface* Measuring Tapes and Leroy† Lettering Equipment. No wonder it's the engineers' encyclopedia.



Factories within a Factory

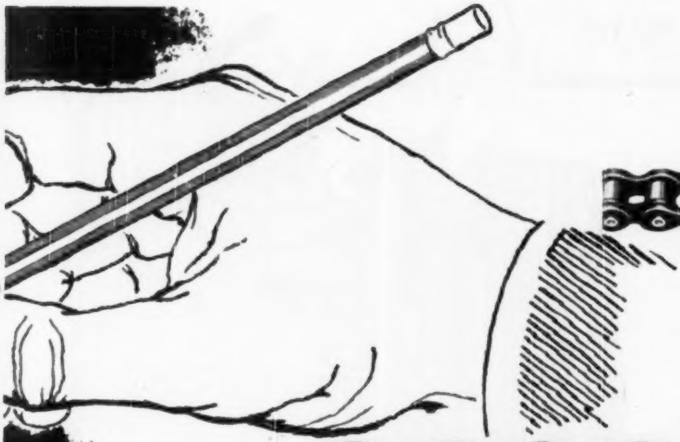
K&E headquarters are a town within a town, many factories within a factory. In one area they're coating miles of papers and cloths. In another they're turning screws so tiny you feel like a hippopotamus if you try to pick one up. Here they're grinding optical lenses. There they're putting graduations no bigger than a fly's kneecap on scales of some sort. Here they're doing fastidiously fine leather work. There they're reeling off steel measuring tapes by the mile.

But wherever you go you are aware of the age-old passion for precision and quality. And I'm not the least bit sorry that today I haven't sold you a single K&E product. I've just tried a little bit to sell you on the people at K&E—and to get you to believe that you can safely make K&E products trusted partners in your own creative work.

K+E
partners in creating
For 83 years K&E equipment and materials have been partners of the draftsman, engineer and scientist in shaping the modern world.

*Trade Mark
†Trade Mark ®

KEUFFEL & ESSER CO.



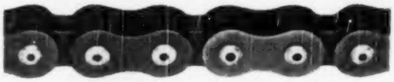
Baldwin-Rex Standard Roller Chain

Rex Cast Pintle Chain

Baldwin-Rex Double Pitch Roller Chain

Rex Chabelco Steel Chain

Rex TableTop® Conveyor Chain



Baldwin-Rex Leaf Chain

Your Rex Field Sales Engineer will be happy to consult with you regarding your application problems. He may be able to help you make substantial savings. Call or write your nearest Field Sales Office. Or, if you prefer, mail the coupon.

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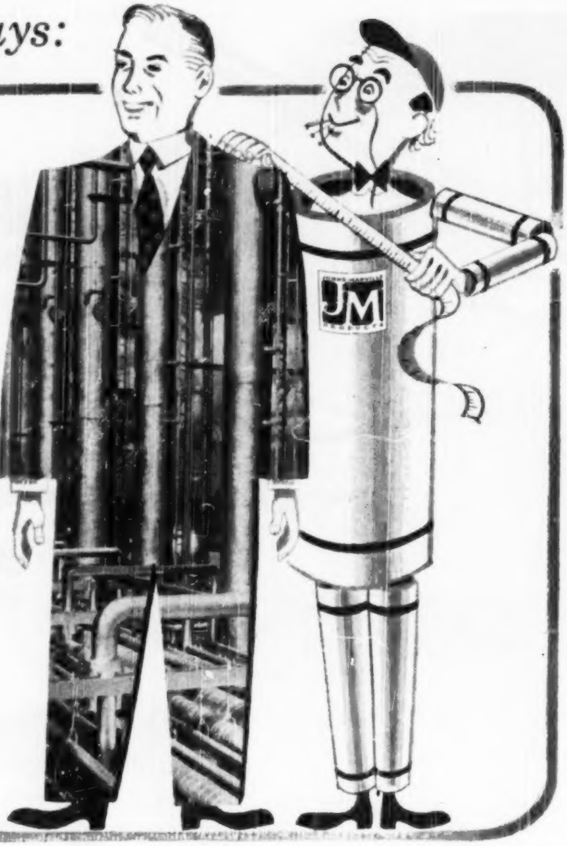


"Buying insulation is like buying a suit of clothes:

—the better the materials; the more expert the tailoring, the better your investment"

Just as no one cloth can be used for every suit of clothes, there is no one raw material that can serve as the ideal insulator for every industrial insulation job.

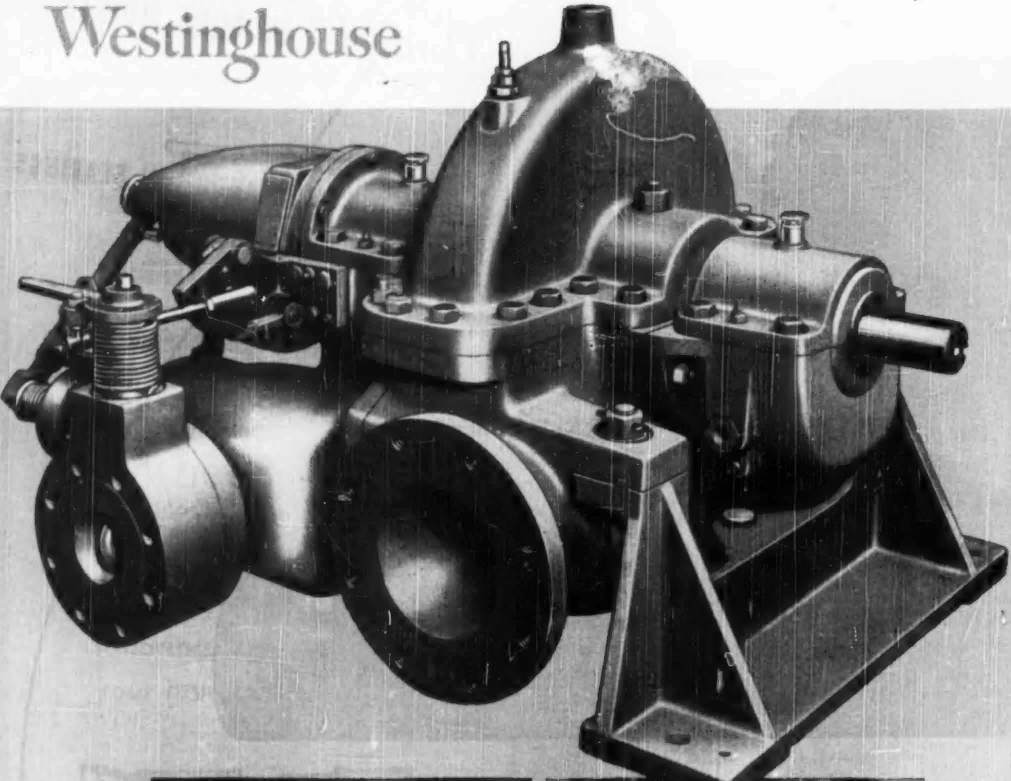
For this reason, Johns-Manville manufactures a wide variety of industrial insulations—of asbestos and other raw materials—each of which is designed for a special purpose. These insulations span the entire range of temperatures from 400 F below zero to 3000 F above.

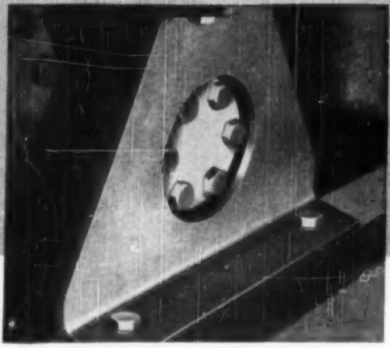
But, again, there is much more to the story of insulations than their manufacture. In order to get the greatest return from your investment in them, they must be expertly engineered to the job, and then skillfully applied.

Johns-Manville makes available to you the service of experienced insulation engineers, and highly skilled mechanics for the proper application of Johns-Manville insulations.

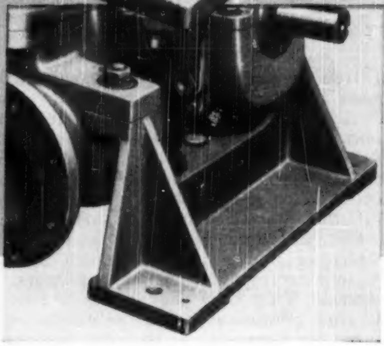
If you are contemplating an insulation installation for your plant, it will pay you to look into this Johns-Manville insulation service. For further information just write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville *first in* **INSULATIONS**





Centerline support at governor end



Centerline support at exhaust end, including vertical kingpin

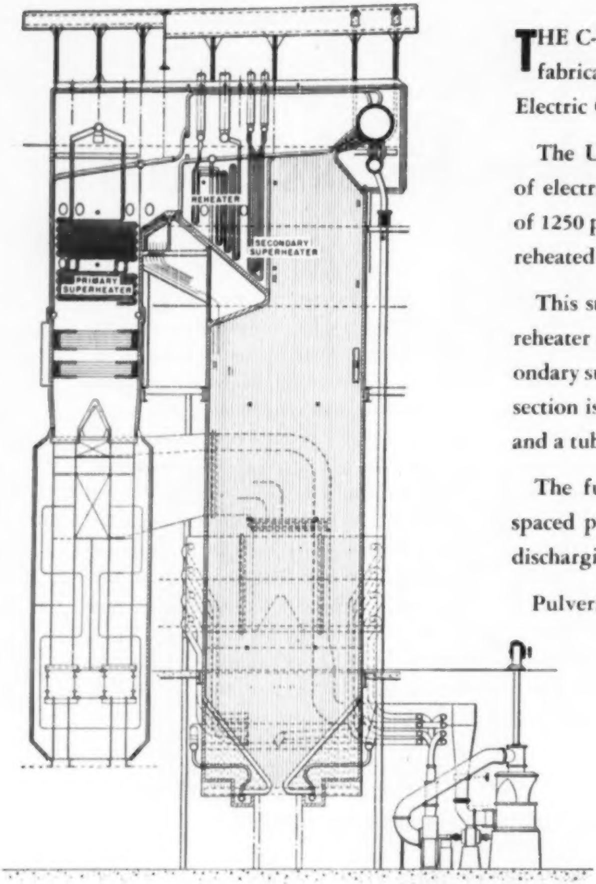
3-WAY CENTERLINE SUPPORT

The Type E method of support allows three-way freedom of expansion and contraction without disturbing the alignment of the rotor shaft. The governor end is mounted on a strong but flexible channel beam to permit axial expansion. At the shaft-coupling end, a unique keyed support connects to the turbine near the shaft centerline to permit lateral expansion; and a vertical kingpin transmits thrust from the expanding steam pipes directly to the foundation and not to the turbine. Thus, the casing is left free to move vertically with expansion or contraction.

C-E REHEAT BOILERS

MERAMEC STATION

UNION ELECTRIC COMPANY OF MISSOURI



THE C-E Unit illustrated here is now in process of fabrication for the Meramec Station of the Union Electric Company of Missouri at St. Louis.

The Unit is designed to serve 125,000 kilowatts of electric generating capacity at a throttle pressure of 1250 psi, with primary steam temperature at 950 F reheated to 950 F.

This steam generator is of the radiant type with a reheater section located between the primary and secondary superheater surface. A finned tube economizer section is located below the rear superheater section, and a tubular type air heater follows the economizer.

The furnace is fully water cooled, using closely spaced plain tubes. It is of the basket-bottom type, discharging to a sluicing ash hopper.

Pulverized coal firing is employed, using bowl mills and tilting tangential burners. Arrangements are made to burn natural gas when and as desired. B-428

COMBUSTION ENGINEERING—SUPERHEATER, INC.

200 Madison Avenue • New York 16, N. Y.

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS, ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

Puzzle for experts

There is no need for "cutting and trying" on the job to make a prefabricated piping sub-assembly fit perfectly. Prefabricated miles away to exact dimensions and specifications these pieces of piping are links in piping systems which may carry steam up to 2500 p.s.i. and 1050°F.

Grinnell integrates the many factors in this complex, highly technical assignment in one organization of specialists. Major economies result from this single responsibility which includes interpretative engineering, metallurgical research, compliance with code requirements, manufacturing drawings and specifications, production schedules, purchase of materials, specialized facilities, skilled personnel, control of quality and rigid inspection.

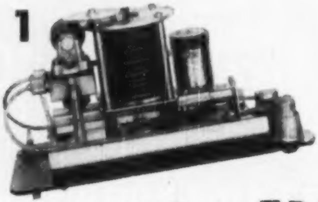
You'll find it to your own best interests to draw upon Grinnell's century-long, specialized experience in power, process and industrial piping.

GRINNELL

Grinnell Company, Inc., Providence, R. I. Branches: Atlanta • Billings • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

TAYLOR TRANSET*

1



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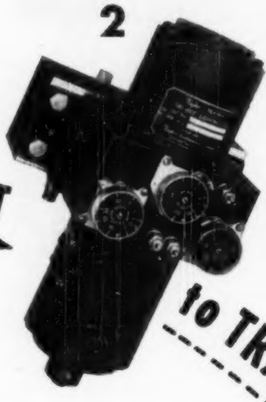
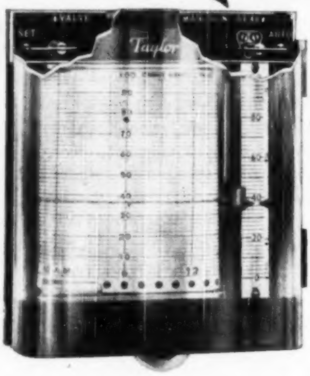


TRANSAIRE to TRI-ACT

to TRANSET

3

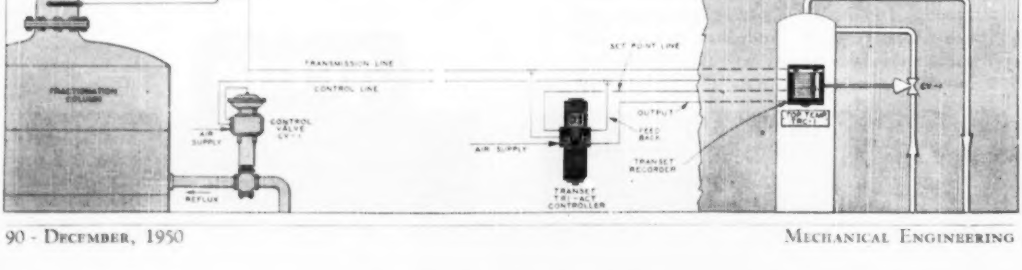


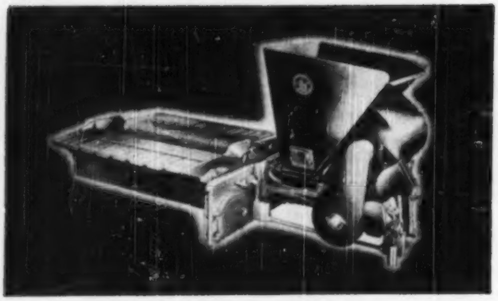
Tinker to Evers to Chance had nothing on Taylor's TRANSAIRE* to TRI-ACT* to TRANSET*. It, too, is a well-coordinated combination. It combines three stars to make the fastest, most dependable pneumatic transmission system on the market.

1. TRANSAIRE. A force-balance temperature or pressure transmitter. SPEED-ACT* gives rate action in the measuring circuit to compensate for process lags. Narrow range spans. Standard 3 to 15 psi output. Interchangeable unit construction.

2. TRI-ACT Controller. A force-balance controller with a new circuit . . . a new concept in process control. High capacity relay air valve for faster response of control circuit. Wider response adjustments than ever before. Panel or locally mounted.

3. TRANSET Recorder. Fits $3\frac{7}{8}'' \times 4\frac{1}{2}''$ opening . . . a natural for graphic panels; a great space saver for conventional panels. Powerful actuation—bellows operated rectalinear movement. 30-day chart, 3-hour visible record. Everything needed for remote control.





UNEQUALED STOKER PERFORMANCE

The present-day Brownell Ramfeed Stokers incorporate the latest improvements along with the original basic design. Many years of experience have proved that this stoker leaves nothing to be desired in efficient, economical, dependable, enduring coal-burning performance.

Made in standard and low-set models, the machines have capacities ranging from 75 to 560 boiler h.p. Each of the twelve sizes has eight feeding rates to meet load variations. Automatic control of coal feed and for air intake is available. The ram stops at innermost position to block gas blow-back. Fuel is evenly distributed and agitated for complete combustion.

Ask for Bulletins S-31 and S-32 describing these heavy-duty stokers.

THE BROWNELL COMPANY

446 North Findlay Street • Dayton 1, Ohio

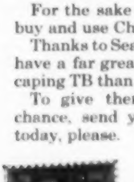
Peace on Earth,

Good Health to Children

For the sake of your children, buy and use Christmas Seals.

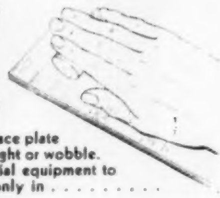
Thanks to Seals, children today have a far greater chance of escaping TB than you did.

To give them a still better chance, send your contribution today, please.



buy Christmas Seals

Test the Extra Quality of LOVEJOY Universal Joints



Put a Lovejoy Universal Joint on a surface plate and roll it. You will neither see daylight or wobble. Thats real concentricity! It takes special equipment to achieve such perfection as you find only in . . . .

LOVEJOY

UNIVERSAL JOINTS

14 sizes. Dia. ¼" to 4". Length 1¾" to 10½". Deliveries from stock.

In Lovejoy Universal Joints high quality heat-treated alloy steel is fabricated to concentricity guaranted to .0005. Rivets are microscopically flush with body. This permits working easily inside tubing, or in very close quarters. Special profiling around forks gives maximum bearing surface, under cut for greatest angle of operation without sacrificing strength. No binding, backlash or inplay. All operating surfaces are finish-ground to such a high degree of accuracy that pins are inserted in perfect alignment. SAVE EXPENSE—gain longest, trouble-free service with EXTRA QUALITY LOVEJOY UNIVERSAL JOINTS.

Send for illustrated literature. See how Lovejoy Universal Joints can save you money. Ask for prices in any quantity.

LOVEJOY 50 CHICAGO

LOVEJOY FLEXIBLE COUPLING CO.

5032 W. Lake St., Chicago 44, Ill.

Also mfrs. Lovejoy L-R Flexible Couplings and Lovejoy Variable Speed Transmissions

MECHANICAL ENGINEERING

November, 1950 CARD INDEX Vol. 72, No. 11

Representatives—Sales Agencies
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OPPORTUNITIES

Positions Open—Positions Wanted—Equipment, Material, Patents, Books, Instruments, etc. Wanted and For Sale

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

POSITIONS OPEN

RESEARCH POSITIONS

Physicists and Engineers with advanced experimental and theoretical experience in

- **Nuclear Technology**
- **Solid State Physics**
- **Physical Metallurgy**
- **Power Plant Components**

are desired for research and development work on direct contract with the Reactor Division of the Atomic Energy Commission.

These positions offer unique opportunities for working with a highly trained group of scientists and for participating in theoretical and experimental studies in nuclear reactor technology. The laboratory is located in the Los Angeles area.

Please write to:

NORTH AMERICAN AVIATION, Inc.

Attention: Personnel Manager

ATOMIC ENERGY RESEARCH DEPARTMENT

12214 South Lakewood Blvd.
Downey, California

GRADUATE MECHANICAL ENGINEERS, CHEMICAL ENGINEERS, OR PHYSICISTS

for research design and development work on rockets, rocket components, and guided missiles. Firm academic background in mathematics, hydraulics, thermodynamics and stress analysis necessary. Experienced in the field of rocketry or allied work. Advanced degree desirable.

Applicant must furnish transcripts of academic record, names of four persons familiar with research ability, complete resumé of past experience and salary desired. All correspondence will be kept confidential.

AEROJET ENGINEERING CORPORATION
P. O. Box 296, Azusa, California

MECHANICAL ENGINEER

For Mechanical Design and Engineering Studies in connection with Electric Utility work. Should have 15 years' experience in similar work.

Write to: Mechanical Engineer, Pennsylvania Power & Light Company, Allentown, Pennsylvania.

RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.50 a line. $1.25 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $25 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

ATOMIC POWER
WESTINGHOUSE ELECTRIC CORPORATION
IMMEDIATE OPENINGS

For experienced senior and junior engineers

*Servomechanism designer experienced in gear trains, bearing applications, differentials, etc.

*Mechanical engineer, materials experience in wear, corrosion, etc.

*Application or design engineer experienced on hydraulics (pumps, hydraulic motors, flow, calculations).

*Process control engineer, capable of making system study of hydraulic circuits, valves, etc.

*Engineer, experienced in aircraft hydraulic control, remote indication, etc.

*Mechanical designers of complete systems in the instrument servo range.

*Process control engineer to design complete servosystems involving all auxiliary apparatus and all controls.

For application write

Manager, Technical Employment,
306 Fourth Ave., Pittsburgh 30, Pa.

MECHANICAL ENGINEER

Permanent position with opportunity for advancement in drafting division of Engineering and Construction Department of major oil company. Location: Philadelphia. Prefer candidate with degree in mechanical engineering, but will consider equivalent training. Must have at least 8 years' drafting experience including supervision. Duties include supervising work of draftsmen engaged in preparing drawings and bills of material for mechanical equipment and services for buildings, pipe lines, terminal facilities, pump stations, etc. Starting salary $523.00 per month. State education, experience and personal history in first letter. Address Mr. H. M. Overley, P.O. Box 7258, Phila. 1, Pa.

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Senior Engineers and Physicists having outstanding academic background and experience in the fields of:

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- Moving Target Indication
- Servomechanisms
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- Fire Control
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- Autopilot Design
- Applied Mathematics
- Electronic Subminiaturization
- Instrument Design
- Automatic Production Equipment
- Test Equipment
- Electronic Design
- Flight Test Instrumentation

are offered excellent working conditions and opportunities for advancement in our Aerophysics Laboratory. Salaries are commensurate with ability, experience and background. Send information as to age, education, experience and work preference to:

NORTH AMERICAN AVIATION, INC.
AEROPHYSICS LABORATORY
Box No. H-4
12214 South Lakewood Blvd.
Downey, California

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MECHANICAL, ELECTRICAL AND ELECTRONIC ENGINEERS AND ENGINEERING PHYSICISTS

Excellent positions on experimental research and development projects related to intricate electro-mechanical and electronic devices.

Men with advanced degrees or equivalent experience may qualify for permanent positions in our laboratories in New York State.

Give full details of education and experience indicating age and marital status.

Address CA-3336, care of "Mechanical Engineering."

Continued on Page 98

Four Pages of "OPPORTUNITIES" This Month . . . 96-99

POSITIONS OPEN

DESIGNERS for HOME APPLIANCES

The Engineering Division of the Hoover Company, world wide manufacturer of home appliances, fractional horse-power motors and commercial die castings, invites correspondence with experienced and capable mechanical designers interested in a position with a company with an assured future. Design experience on home appliances desirable but experience on other mass-produced light mechanical devices may be suitable. Design problems encompass use of die castings compression and injection plastic and rubber moldings, metal stampings and other manufacturing process. Complete laboratory and experimental shop facilities of a research and development group, numbering over 140 people, available to supplement designers' work. Interviews may be arranged. Address reply to: The Hoover Company, Attention: Chief Engineer, North Canton, Ohio.

MACHINE DESIGNERS

A large Middle West machine tool builder requires the services of several capable machine tool designers with a technical and practical background. Splendid opportunities available for qualified persons. Give complete details of self, education, experience and salary expected.

Address CA-3333, care of "Mechanical Engineering."

PRODUCTION AND METHODS ENGINEER

Highly regarded medium size manufacturing company in Middle West is seeking an experienced engineer. Will be responsible for determining manufacturing methods from design through tooling and fabrication to completed product. Products mostly sheet metal and light assemblies. Not home appliances but similar in scope. Candidates must have experience in above work. Degree in engineering required. Salary commensurate with qualifications. This is a very good opportunity. Replies will be held in strict confidence.

Address CA-3376, care of "Mechanical Engineering."

MECHANICAL ENGINEERS

Positions available at various levels for graduate, experienced engineers. General knowledge of manufacturing processes and application of light weight alloys preferred. Openings for developmental work on communications radar equipment—layout, design and development of mechanical components, chassis, and equipment housing. Salary: $325 to $550 per month, depending on specific qualifications. Send complete resumé to: A. H. Ford.

BENDIX RADIO DIVISION
Baltimore 4, Maryland

WANTED
DEVELOPMENT ENGINEER
Milwaukee, Wisconsin Area

Mechanical Engineer with ten or more years of experience in design and development of sheet metal products. Should have the inventive type of mind, good practical knowledge of dies, tools and equipment, and ability to organize and direct small group employed to create new sheet metal products and machinery for their manufacture.

Excellent opportunity with long established company.

Give details of age, family, education, training, experience, list of former employers, and salary expected in first letter. All applications will be held in strict confidence before and after the interview.

Address CA-3369, care of "Mechanical Engineering."

ADMINISTRATIVE ASSISTANT

Graduate in Engineering and Business Administration, preferably with one or two years of experience, for position as Administrative Assistant in research laboratory. Location Detroit. Send complete resumé and salary desired.

Address CA-3386, care of "Mechanical Engineering."

GRADUATE MECHANICAL ENGINEER

of executive calibre is required to fill permanent staff position (Chief Mechanical Engineer) of company producing a large volume of precision metal stampings for the electrical and electronics industries (both civilian and defense). Experience in the design of modern precision stamping dies and the operation of high speed presses is desirable. Must have ability to design light and heavy automatic handling equipment for raw materials and finished products. Salary commensurate with ability, experience and background. Submit detailed resumé.

Address CA-3396, care of "Mechanical Engineering."

DEVELOPMENT ENGINEER—Mechanical—diversified—broad experience. Work involves machine design, stress analysis and experimental tests. Opportunity for responsibility, exercise of ingenuity. Age about 35.

DESIGN ENGINEER—Mechanical—Product design. Capable taking responsibility. Age about 35.

Company manufactures pressure vessels and allied equipment. Above positions are of significant importance. Please submit complete resumé.

Address CA-3388, care of "Mechanical Engineering."

GRADUATE MECHANICAL ENGINEER—with several years of design, construction and maintenance experience wanted for permanent position in sugar industry in Cuba. Salary open. Address CA-3345, care of "Mechanical Engineering."

CONTROL VALVE DESIGNER—preferably young graduate engineer with some related experience. Exceptional opportunity to grow with progressive, nationally known company. Address CA-3353, care of "Mechanical Engineering."

DEVELOPMENT ENGINEER—Excellent opportunity open with nationally known manufacturer of temperature and pressure responsive instruments. Should have either M.E. or E.E. degree, experience with Bourdon tubes and diaphragms desirable. Give full details of background in first letter. Write Personnel Director, Perfex Corporation, 500 W. Oklahoma Ave., Milwaukee 7, Wisconsin.

EXPERIENCED POWER STATION ENGINEER—for Administrative Work. Education: B.S. Degree in Mechanical (preferred) or Electrical Engineering from an accredited college or university. Experience: Minimum of 10 years with at least 5 years in connection with steam-electric power generation. Work in operation, maintenance or efficiency desirable. Construction and design experience acceptable. Age: 30-45. Location and Industry: Large Pennsylvania electric utility. Salary commensurate with qualifications. Please send personal record. Address CA-3366, care of "Mechanical Engineering."

ENGINEER—position for man with broad and varied experience, must be able to design chemical process piping and equipment. Must be excellent draftsman willing to do board work. Graduate preferred, but man with equivalent experience will be considered. In reply, please state qualifications and salary desired. Emery Industries, Inc., 4206 Carew Tower, Cincinnati 2, Ohio. Attention Personnel Director.

EXCELLENT OPPORTUNITY—Junior hydraulics engineer to assist chief hydraulic engineer with large manufacturer of tractor equipment and heavy excavating machinery. State fully educational background and experience, draft status, and salary expected. Location southeastern Wisconsin. Address CA-3374, care of "Mechanical Engineering."

BLAST FURNACE ENGINEER—Experienced Engineer with background of design and operation of blast furnaces, blast furnace auxiliaries and components. Unusual opportunity to do design and sales work. Salary commensurate with ability and experience. Submit resumé. John Mohr & Sons, 3200 E. 96th Street, Chicago, Illinois.

PLANT ENGINEER—Excellent opportunity with large company, Technical Graduate with 15-20 years' experience in design maintenance and power plant operation in chemical processing industry. Location—Chicago. Give age, education, detailed experience, and salary expected. Address CA-3384, care of "Mechanical Engineering."

HEAT TREATER—METALLURGIST—At least 5 years' experience in hardening of tools and dies, to supervise heat treating department of well established, nationally known jewelery manufacturer in Metropolitan, New York area. Will be responsible for the heat treating of dies and annealing of jewelry parts. Reply stating age, experience and salary desired. Address CA-3390, care of "Mechanical Engineering."

DRAFTSMAN—centrifugal pumps, should be experienced in drawing multi-stage pumps, etc. Excellent opportunity in southern Ohio for man with sound design sense. Give full details training and experience. Address CA-3392, care of "Mechanical Engineering."

MECHANICAL ENGINEER—with experience in design and piping layouts of large steam power plants. State age, technical training, experience, and salary desired. Reply to Chief Design Engineer, Duke Power Company, P. O. Box 2178, Charlotte, N. C.

MECHANICAL DRAFTSMAN—with piping layout experience in connection with large power plants. State age, experience, and salary desired. Reply to Chief Design Engineer, Duke Power Company, P. O. Box 2178, Charlotte, N. C.

ENGINEERS—wanted for industrial fire prevention field work by national insurance organization with offices in most major cities. These are permanent jobs with a real future, but candidates should appreciate that extensive away from home travel is involved. Age 26-40 preferred. Address CA-3395, care of "Mechanical Engineering."

Four Pages of "OPPORTUNITIES" This Month . . . 96-99

POSITIONS WANTED

MECHANICAL ENGINEER—Registered, BSME, ASME. Age 25, married, $2^1/_2$ years in Power Plant Design. Desire permanent position in Power Plant Design or Allied Field. Midwest Preferred. Address CA-3368, care of "Mechanical Engineering."

EXPERIENCED MECHANICAL ENGINEER—with electrical background seeks new connection offering greater responsibilities. College Graduate, B.S. and M.S. degrees, state registered. Twelve year work record includes Research and Development, Product, Design and Manufacturing, and field contact. Aggressive, Co-operative, Good Earning Record. Can furnish excellent references, will relocate. All replies acknowledged and held strictest confidence. Address CA-3372, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Age 33, Experienced Aircraft, industrial Equipment, construction design installation, maintenance. Desires position in South America. Address CA-3379, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Dr. Ing., Dipl. Ing., Technische Hochschule Munich (Germany), U. S. Citizen, 30, family. Seeks interesting, responsible position in research and development. Several years exp. in industry and research. At present instructor of math. at a University, N. Y. State. Address CA-3381, care of "Mechanical Engineering."

MECHANICAL ENGINEER—with four years' experience in gas turbine stress analysis. Familiar with design of both aircraft and stationary turbine Power Plants. Address CA-3382, care of "Mechanical Engineering."

MECHANICAL ENGINEER—Member of ASME, Age 48; Married, Registered Graduate Engineer, now employed, desires change for a more responsible position as Mechanical or Assistant Chief Engineer. Twenty years of diversified mechanical experience involving Design, Testing, Patent Developments, Inspection, and Administration Duties. Will travel if necessary. Address CA-3341, care of "Mechanical Engineering."

PROFESSORSHIP OF APPROPRIATE GRADE—wanted by man 34, Ph.D. (Cornell), with varied experience teaching and research in applied mechanics: stress analysis, structures, elasticity, vibrations, and other branches. Address CA-3351, care of "Mechanical Engineering."

REPRESENTATION WANTED

ENGINEERING SALES REPRESENTATIVES—wanted in principal cities to handle complete, quality line of air and hydraulic cylinders. Write in confidence stating lines now being handled, territory covered and references. Ledeen Mfg. Co., 1600 S. San Pedro St., Los Angeles 15, Calif.

SALES REPRESENTATIVE—wanted to sell gas valves, filters, pressure regulators, etc. to gas companies, manufacturers and jobbers. Write in confidence stating companies now represented, territory covered, and references. Gas & Oil Industry Laboratory, Irvington 11, New Jersey.

EQUIPMENT FOR SALE

FOR SALE—TWO 300 H.P. BOILERS & ACCESSORIES

Complete steam generating plant. Two Keeler Type CP, two drum, bent tube, water cooled furnace type boilers with heating surface 3000 sq. ft. each. W.P. 250 psi and nominal 300 HP each. Steam rating 9880 lbs. per hr. at 100% nominal rating. Riley-Jones stokers, single retort with moving grates 59 sq. ft. projected area, steam ram drive. Clarage fans 9825 c.f. per min. at 4 in., one steam turbine, one electric drive. Meters and instruments. Boiler feed pumps. Deaerating boiler feed water heater. All installed 1942. Now in use and good condition in northern Ohio. Available approximately Nov. 1951. Contact Burgess & Niple, Agents, 584 East Broad Street, Columbus 15, Ohio.

If you desire capital or have it to invest, if you have a patent for sale or development; if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact, anything to be offered that somebody else may want, or anything wanted that somebody else may have—

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PLANT PERSONNEL, ENGINEERS, DESIGNERS—Draftsmen, Chemists, and Metallurgists, E. G. Stroud, Member ASME and President of Cleveland Engineering Agency Co., 2132 E. 9th St., Cleveland 15, Ohio, will help you find positions or men.

Immediate openings: CHIEF DRAFTSMAN—for utility power plant design—$10,000; Steam Plant Design Engr.—$[illegible]; Sheet Metal Tool Engr.—$8400; Utility power plant design Engr.—$10,000; Many others. Tomsett Associates, 1205-1 Berger Bldg., Pittsburgh 19, Pa.

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection, communicate with the undersigned. We offer the original personal employment service (40 years' recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby Inc., 115 Dun Bldg., Buffalo, N. Y.

SALARIED PERSONNEL $3,000—$25,000

This confidential service, established 1927, is geared to needs of high grade men who seek a change of connection under conditions, assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited.

JIRA THAYER JENNINGS
Dept. J, 241 Orange Street, New Haven, Conn.

BUSINESS OPPORTUNITIES

DIESEL ENGINES AVAILABLE—for manufacturing agreement: Air-cooled engine, light, 1 & 2 cyls. 6 & 12 HP/1800 RPM. Water cooled engine, light, 11 HP/1800 RPM. These engines are production designed, have had field tests for defense purposes and are ready for adaption to production. Address CA-3383, care of "Mechanical Engineering."

REPRESENTATIVES AVAILABLE

A well established incorporated company desires TO REPRESENT A MANUFACTURER of high grade power plant equipment in Northern Ohio territory. Address CA-3283, care of "Mechanical Engineering."

MANUFACTURERS REPRESENTATIVE—established over 12 years in Pennsylvania, New Jersey and Delaware, desires additional line mechanical equipment. Can give complete engineering representation. Power Plant or Process Industry preferred though not essential. Address CA-3342, care of "Mechanical Engineering."

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Consulting Engineers
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MUrray Hill 6-4630

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Transmission Systems
Design, Supervision, Inspection
Appraisals, Reports
SARGENT & LUNDY
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to work out solutions
to your engineering and management problems.

Index To Advertisers

KEEP INFORMED—Pages 41-68 | **DECEMBER, 1950** | **OPPORTUNITIES—(classified ads) Pages 96-99**

✶ **The asterisk indicates that firm also has product catalog in the 1951 ASME Mechanical Catalog and Directory**

The Only Reference Annual Covering the Mechanical Engineering Field with a Unique Combination of Complete Equipment Directory and Manufacturers' Catalogs. Up-to-date 20-page Insert Catalog of ASME Publications is included. *Published Annually.*

CONSULTING SERVICE . . . Page 100

Advertisers in previous 1950 issues but not in this issue

MECHANICAL ENGINEERING, 29 W. 39th St., New York 18, N. Y.

Additional information is requested on the following advertisements in the December 1950 issue

Page No. ***Name of Advertiser***

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Name________________ **Title**________

Company________________________

Address________________________

City________________ **State**________

Reader Service Coupon For More Information

Go through the advertising pages and jot down the page numbers and names of advertisers about whose product you want additional information — mail the coupon to us — your request will be passed on to the advertiser promptly — you will hear directly from advertiser — saves your time in writing individual letters.